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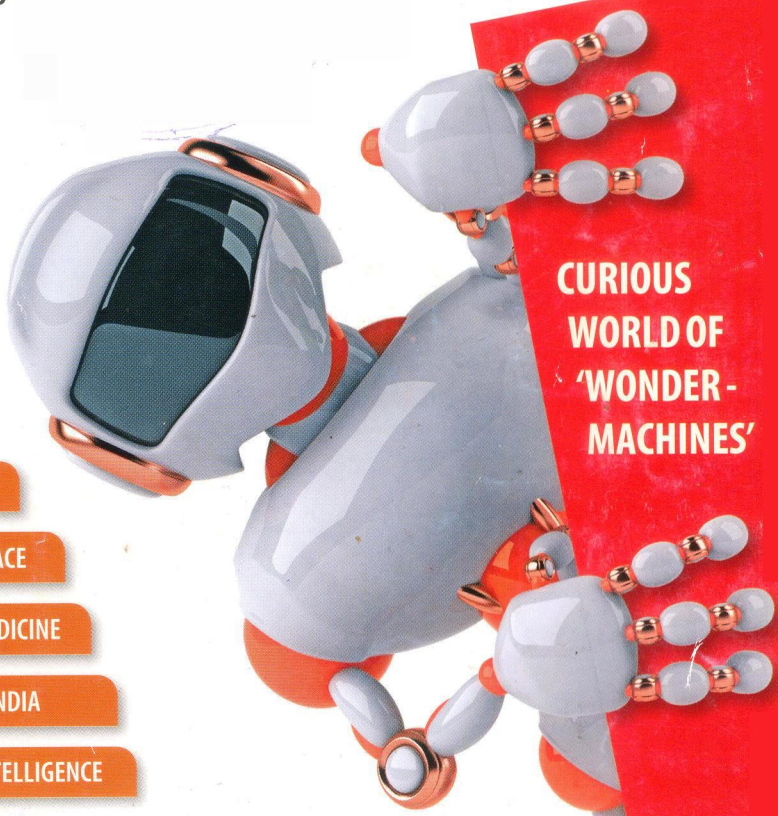

CURIOUS WORLD OF 'WONDER-MACHINES'

- HUMANOIDS
- ROBOTS IN SPACE
- ROBOTS IN MEDICINE
- ROBOTICS IN INDIA
- ARTIFICIAL INTELLIGENCE

robots

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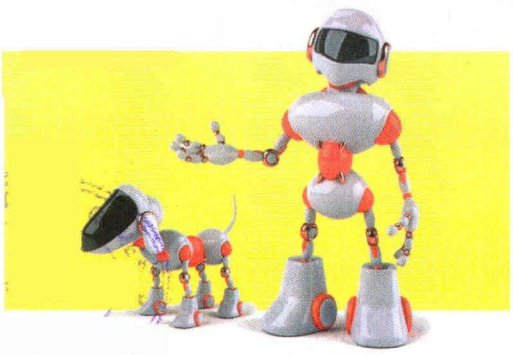
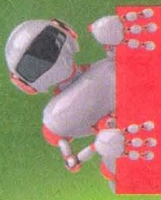


O Robo! My Robo!

The workers of that factory never rested. They never ate, never slept, or complained about anything. Work, work and more work... round the clock. But one day, they came out, led a revolution against their masters, and humbled Man. These workers were robots, a figment of the author Karl Capek's imagination.

However, in 1960, fiction became reality when the first real life robot made its appearance. Since then, robots have influenced human life tremendously. Today, there are robots smart enough to defeat a world chess champion like Gary Kasparov. The robot Deep Blue once did it!

This issue of 'Tell Me Why' takes you to the fascinating world of robots.



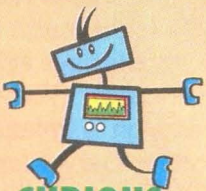
THE WORLD OF ROBOTS

What is a robot?

The word 'robot' means any man-made machine that can perform work or other actions normally performed by humans, either automatically, or by remote control.

Most robots today are used to do repetitive actions or jobs considered too dangerous for humans.

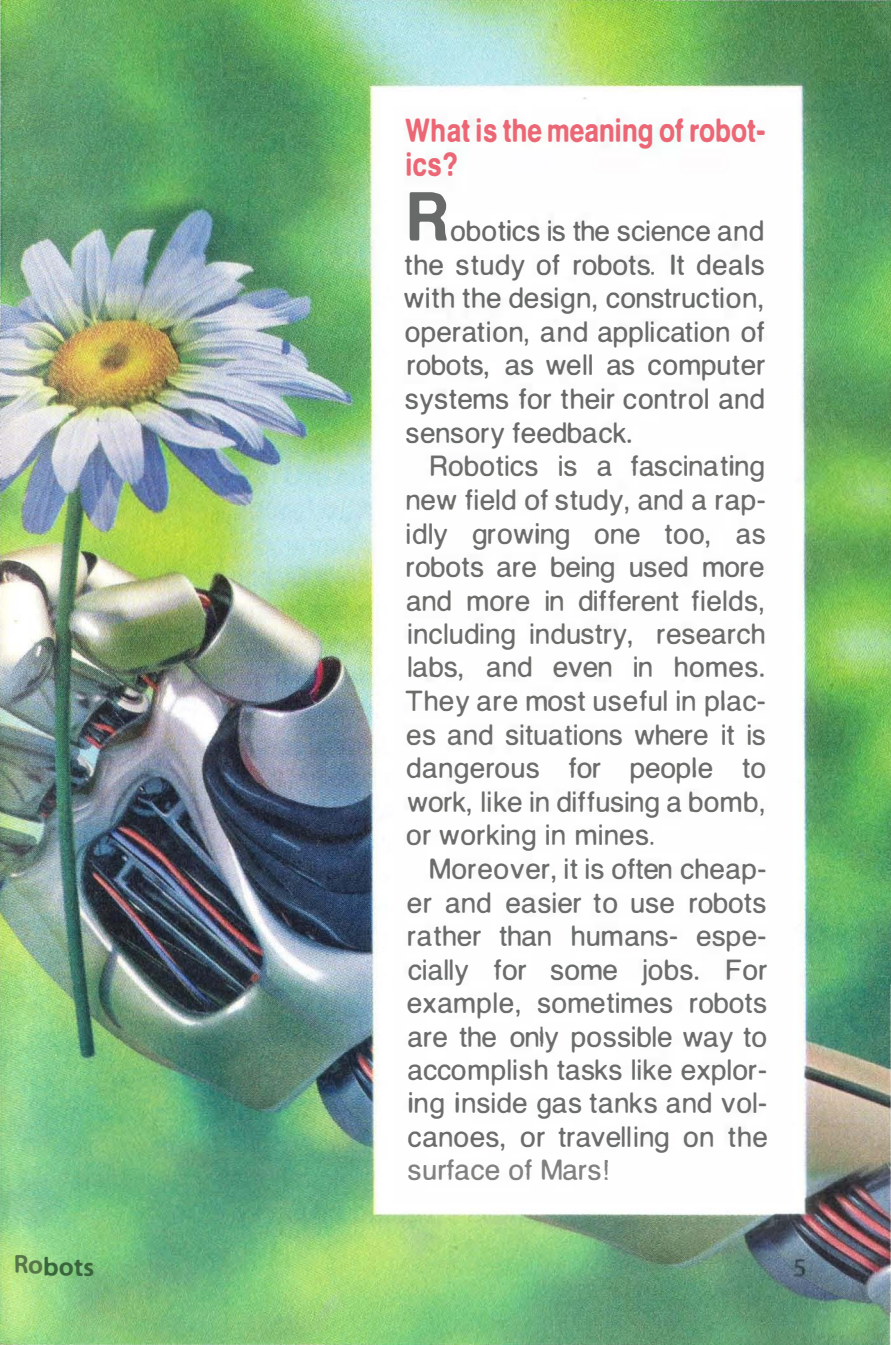
Robots can be made to look like humans or animals, but this is not always the case. Industrial robots, for example, do not have a human form at all, but they do the jobs that human beings used to do previously. Robots can be big, small, or very, very tiny.



CURIOUS FACT

First to Film

Metropolis was a movie that was first shown in 1927. Directed by Fritz Lang, the story revolves around a magnificent man made machine with a human form.

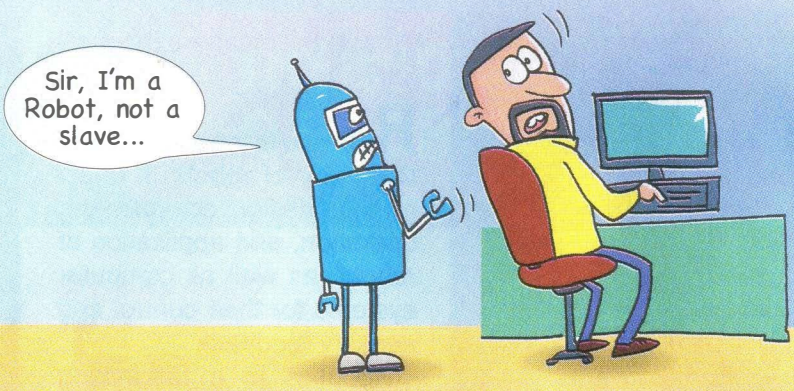


What is the meaning of robotics?

Robotics is the science and the study of robots. It deals with the design, construction, operation, and application of robots, as well as computer systems for their control and sensory feedback.

Robotics is a fascinating new field of study, and a rapidly growing one too, as robots are being used more and more in different fields, including industry, research labs, and even in homes. They are most useful in places and situations where it is dangerous for people to work, like in diffusing a bomb, or working in mines.

Moreover, it is often cheaper and easier to use robots rather than humans- especially for some jobs. For example, sometimes robots are the only possible way to accomplish tasks like exploring inside gas tanks and volcanoes, or travelling on the surface of Mars!



Where does the word 'robot' come from?

'Robot' is actually a Czech word that means 'slave'. The word is the brainchild of the Czech playwright, novelist, and journalist Karel Capek, who introduced it in his 1921 hit play, R.U.R., or Rossum's Universal Robots.

It tells the story of a company that uses the latest biology, chemistry and physiology to mass produce workers who 'lack nothing but a soul'. The robots perform all the work that humans preferred not to do and, soon, the company is inundated with orders.

In the play's final act, the robots revolt against their human creators. In the end, two robots somehow acquire the human traits of love and compassion and go off into the sunset to make the world anew.

Audiences loved the play, and soon after, robots became the darling of science fiction writers. The first digital and programmable robot was invented by George Devol.

Karel Capek

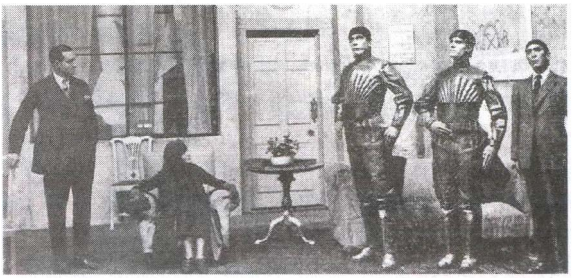
What is the difference between automatons and robots?

The word 'robot' is a comparatively new one. Two thousand years ago, people tried to build mechanical objects that looked, and moved like humans and animals. Such a machine was known as an automaton.

It can perform only a single set of actions. These self operating machines were quite common, even in ancient times.

The emperor Theophilos' palace, for example, had "lions, made either of bronze or wood covered with gold, which struck the ground with their tails and roared with open mouth and quivering tongue," An automaton cannot change any of its movements, and has no intelligence of its own.

Today's robots on the other hand, have artificial intelligence, and can perform many tasks – but the fact remains that automatons are surely the ancestors of the present day sophisticated robots.



A Scene from Rossum's Universal Robots

HISTORY BEGINS

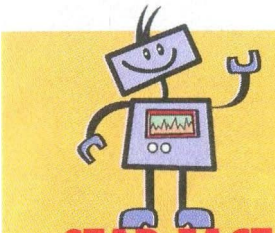
Why does the history of robots go back to ancient times?

Japanese Puppet Karakuri serving tea

It is true that robots are a modern phenomenon, but they have existed in some form, since ancient times.

Robots have been mentioned in mythology too. It is said that a Greek god called Hephaestus made robot like models to help him in his workshop. It is known that self operating machines did exist in Ancient China, Greece, and Egypt, and some of them resembled animals or humans.

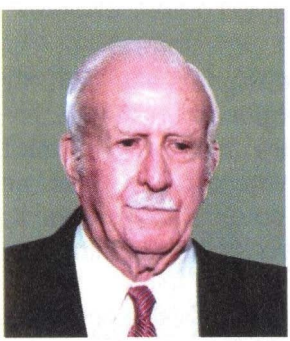
Of course, there weren't any electronics or stuff like that involved in these - ancient people simply used



STAR FACT

The Word Robotics

The science fiction writer Isaac Asimov coined the word 'robotics'. He also set down 'the three laws of robotics,' around which his books were written.



George Devol

mechanical principles they already knew about.

The Ancient Chinese are also known to have created mechanical birds, phoenixes, and magpies. Though made of wood, some of these creations could be made to pretend to eat, chirp, and warble like real birds!

When does the history of modern robotics begin?

The history of modern robotics begins with the Industrial Revolution, which ushered in an era of complex mechanics, and the use of electricity.

This in turn, led to the invention of power machines with small compact motors.The first robots were simple fixed machines, capable of performing manufacturing tasks which allowed production without the need for human assistance.

In 1954, George Devol designed the Unimate, a robotic arm device that transported die castings in an automobile plant in US, which started work in 1961.

The 1960s saw the arrival of digitally controlled industrial robots. Robotics became a burgeoning science, large investments were made, and robotics spread to Japan, South Korea, and many parts of Europe rapidly.

W.H. Richards with 'Eric'

What are humanoid robots?

Leonardo Da Vinci designed and built the first known humanoid robot around 1495.

Humanoid robots are built to resemble human beings. Da Vinci's robot was an armoured knight that could sit up, wave its arms, and move its head while opening and closing its jaw.

By the 18th century, elaborate mechanical dolls were able to write short phrases, play musical instruments, and perform other simple, life-like acts.

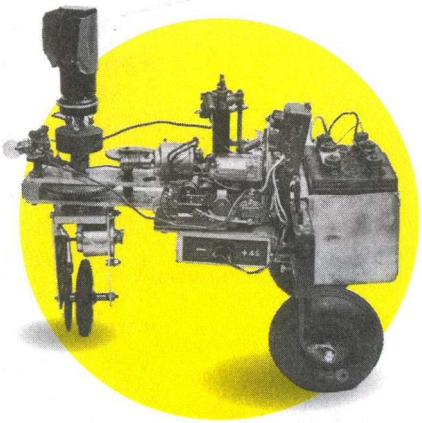
The first ever exhibited humanoid robot was 'Eric'. It was invented by W.H. Richards in 1928, and was exhibited at the Society of Model Engineers in London.

At the 1939 and 1940 World's Fairs, the Westinghouse Electric Corporation exhibited the tall motor man Elektro.

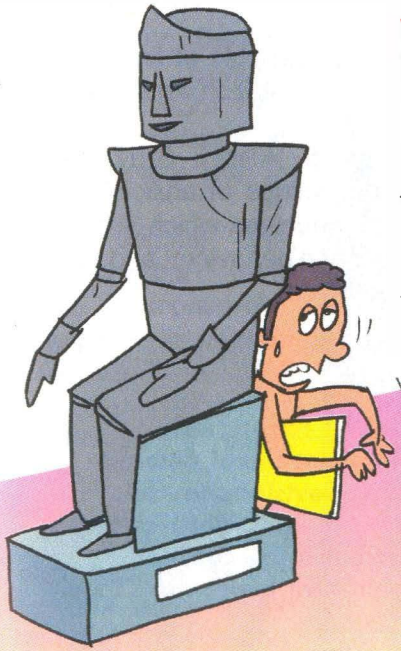
Humanoid in appearance, it could drive on wheels in the feet, play recorded speech, blow up balloons, and move its head and arms. Elektro was controlled by 48 electrical relays, and could respond to voice commands.

In 1973, the construction of a human-like robot was started at the Waseda University in Tokyo. Wabot-1 was the first full-scale humanoid robot able to walk on two legs. It could also communicate with a person in Japanese.

Honda's Asimo robot was built to capture the public imagination, and show off the company's technical prowess.



Walter's Robotic Turtle



Why is William Grey Walter an important name in robotics?

William Grey Walter built some of the first robotic turtles in the 1940s.

They were named Elmer and Elsie, and were called robotic turtles because of their shape and slow movement. They were

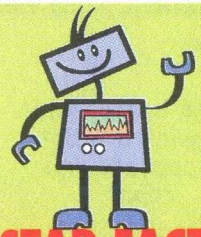
the first electronic autonomous robots.

These domed mechanised devices on wheels twirled and gyrated, avoided obstacles, backed away from the edges of their enclosure, and trundled purposefully towards a light source beamed in their direction.

William Grey Walter

They were also capable of finding their way to a recharging station when they ran low on battery power.

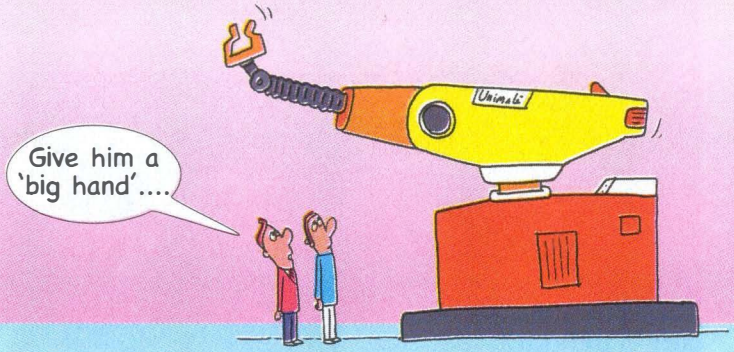
The tortoises of William Grey Walter marked the beginnings of artificial intelligence, and of machines which simulated human thought and behaviour, and therein lies their importance.



STAR FACT

Amazing

Unimate, the first robotic arm, designed by George Devol, amazed audiences of a television show by demonstrating its skills, which included putting a golf ball into a cup, and waving an orchestra conductor's baton.



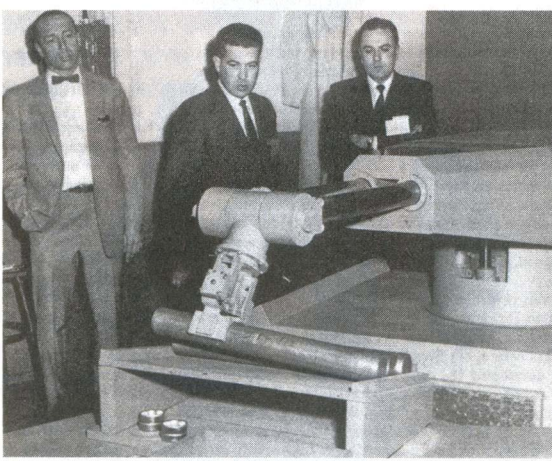
Why was the Unimate considered a wonderful invention?

The concept for Unimate was developed by inventor George Devol. General Motors bought the device, installing it on an assembly line in 1961.

The original Unimate consisted of a large computer-like box, joined to another box, and was connected to an arm, with systematic tasks stored in a drum memory.

The first robotic arm was installed at the General Motors plant for lifting and stacking hot metal parts. Unimate was the first digitally operated and programmable robot, and it laid the foundations of the modern robotics industry.

Soon, a variety of other tasks were also performed by robots, and Unimate industrial robots became one of the most widely used industrial robots in the world.



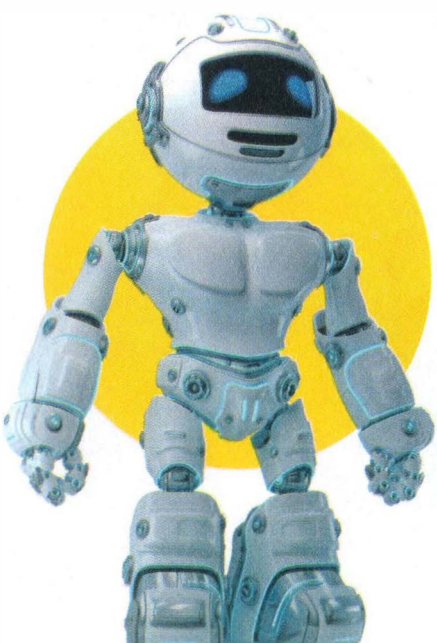
Unimate - The Robotic Arm

WORKING ROBOTS

What are the major components of a robot?

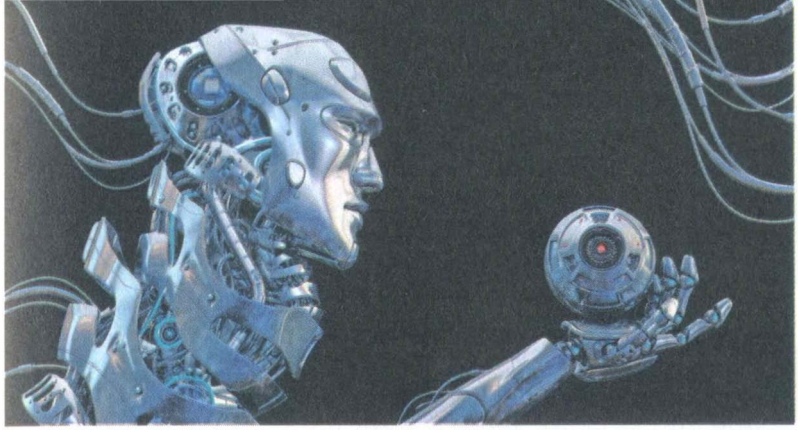
Just as we use the different parts of our bodies for different purposes, robots are also made up of different components that perform different tasks.

A robot has five main parts - a controller, arm, drive, end effector and sensor. Every robot is connected to a computer which keeps its parts working together, and this computer is known as the controller.



The arm is the part of the robot that positions the end effector and sensor, and allows it to do its programmed work. The end effector acts like a hand attached to the robot's arm, and is used as a tool for doing a particular task.

Sensors send information in the form of electronic signals to the controller, which acts like the brain in the human body. The drive is like the engine that powers the robot. Without the drive, the robot would not work.



CURIOUS FACT

Giant Japan

The Japanese are the giants in the field of robotics. They have overtaken the Americans, and today, at least half of the more than million industrial robots in use are Japanese.

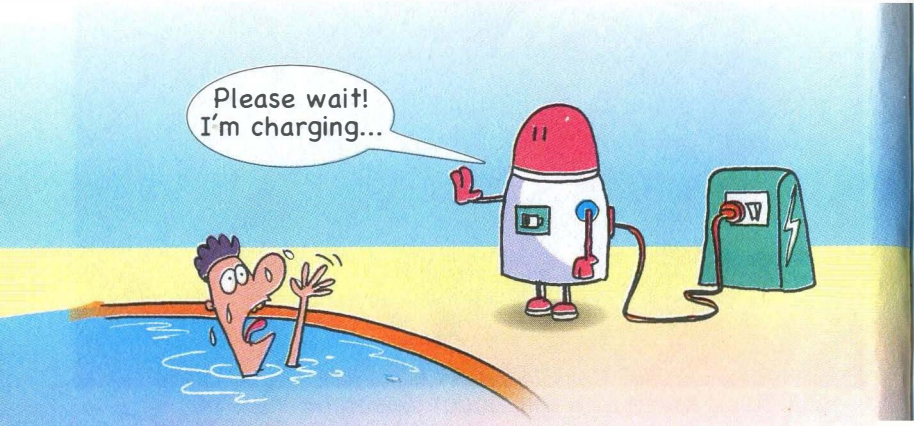
How are robots classified?

There are two basic types of robots- those that are fixed, and those that are mobile. A fixed robot is attached to a stationary platform.

It remains in one place while doing the task assigned to it, just like a person who stands in one place while working. Many industrial robots are fixed robots.

Mobile robots, on the other hand, move from place to place either on wheels, or on legs, or by crawling. Wheels are usually preferred for rough surfaces, and legs for smooth ones.

Mobile robots are becoming more common in commercial settings. Hospitals and warehouses use them to move materials from one place to another.



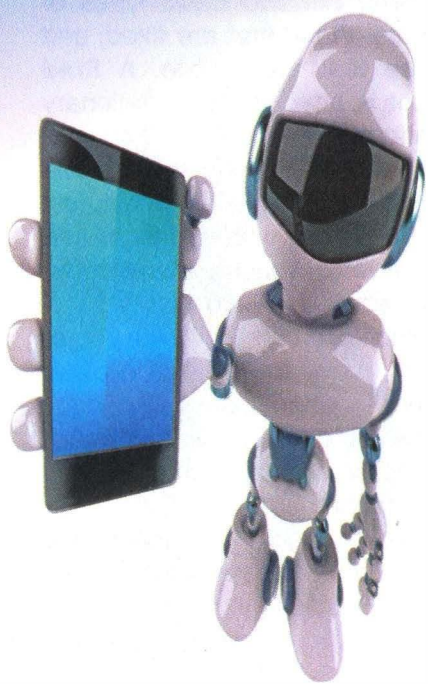
How does a robot work?

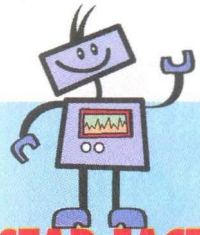
Robots are machines that replicate human and animal behaviour.

A typical robot has a movable physical structure, a motor or drive of some sort, a sensor system, a power supply, and a computer 'brain' that controls all of these elements.

A robot cannot think on its own. To work, it needs a clear set of instructions telling it what to do, and how to do it. Most robots will receive these instructions from a computer.

These instructions are given in the form of electrical signals. The signals tell the robot which parts to move, so that it can perform the task it is supposed to do.





STAR FACT

Sky Wash

Washing an aeroplane can take up to twelve hours. But, a giant robotic arm named 'Sky Wash' can do the job in just three!

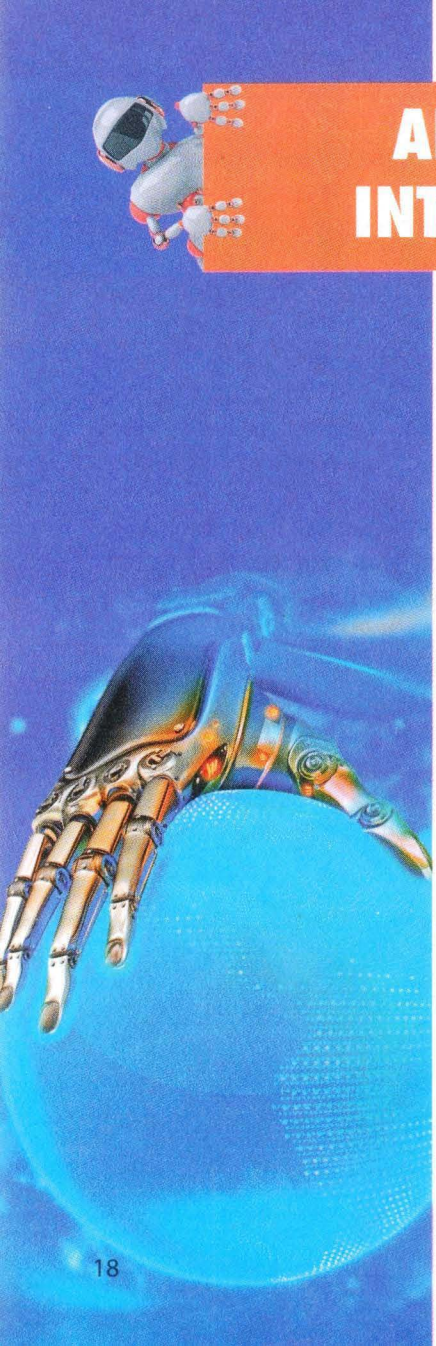
What are robotic arms?

Robotic arms are mechanical devices that serve the same essential functions as a human arm, such as grasping and lifting.

A robotic arm's design is determined by the task it is required to perform. Generally speaking, robotic arms have a base that allows limited turning, with additional joints that allow either up-down, or left-right motion.

Most robotic arms used for industrial applications perform tasks such as picking something up, and placing it elsewhere.

Robot arms are particularly useful in jobs where precise part placement, such as in electronic equipment, is important. Attachments to robotic arms can include simple grasping devices, or even welders.



ARTIFICIAL INTELLIGENCE

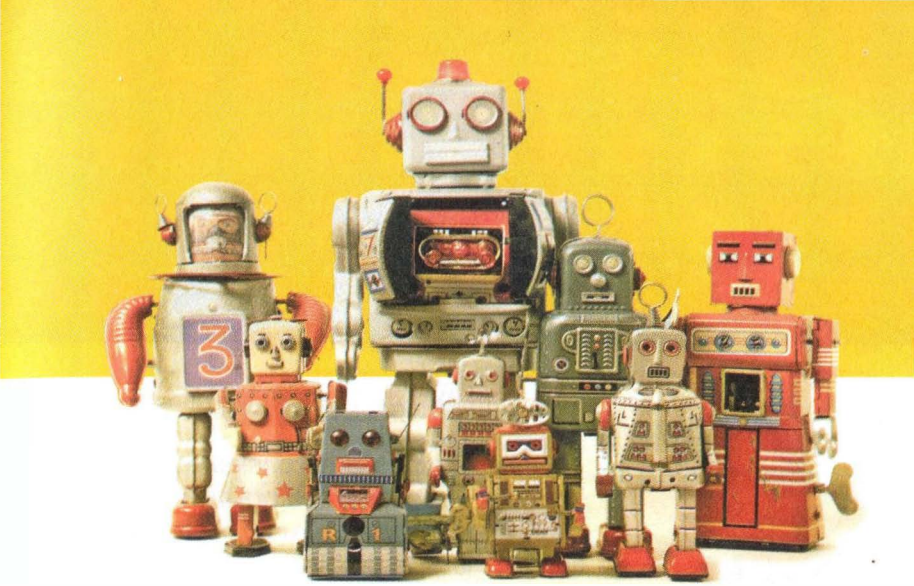
What is Artificial Intelligence?

Ever since machines were invented, scientists have dreamt of making them learn and perform intelligent tasks – like humans.

Artificial intelligence is a branch of science which is into making machines think like humans. These machines, or computers, can store large amounts of information, and process them accurately, at an amazing speed.

What they lack is the ability to learn, and make 'intelligent decisions'. Scientists are creating new software programmes which try to recreate the process of human learning in a computer, in an attempt to make them 'think'. These programmes try to copy the functioning of the brain.

When a computer or robot has the power to think and make decisions without any outside instructions, it is said to have Artificial Intelligence, or AI.



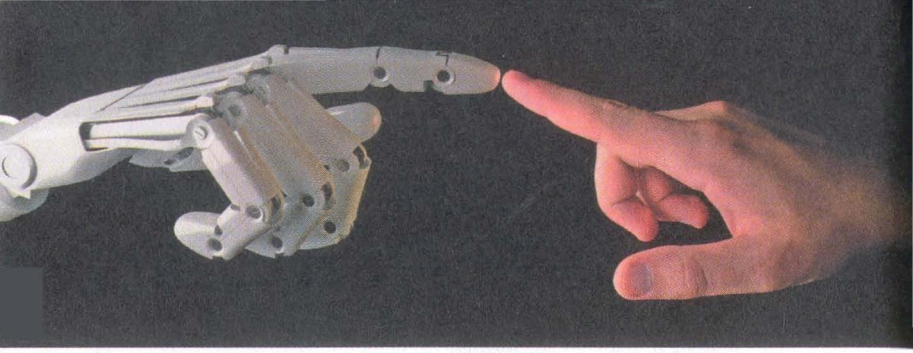
What progress has been made in the field of Artificial Intelligence?

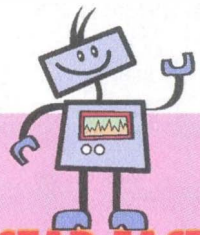
The beginnings of the science of Artificial Intelligence or AI can be traced to the invention of the programmable digital computer in the 1940s. It's a machine based on the abstract essence of mathematical reasoning.

This device, and the ideas behind it, inspired a handful of scientists to begin seriously discussing the possibility of building an electronic brain.

The person who finally coined the term 'Artificial Intelligence,' and is regarded as the father of AI, is John McCarthy.

In 1956, he organized a conference at Dartmouth to draw the talent and expertise of others interested in machine intelligence. After a month of brainstorming, the attendees wrote programmes that were simply astonishing. Since then, advances in Artificial Intelligence have given the world, among other things, computers that can beat people at chess, drive cars, and manage day to day works.





STAR FACT

Dancing Robot

In Japan, programmers have created dancing robots. They have done this by demonstrating the moves which the robot stores in its memory. The robot cannot think of a new move by itself, like you can.

What makes a machine intelligent?

Human beings are considered to be intelligent, because their brains have the capacity to handle the unexpected, and find solutions to problems.

A machine should be able to make decisions on its own and find solutions to problems, in order to be considered intelligent.

For example, in an assembly line, two triangular parts may reach a worker in a position that is different from the normal one. The worker would instantly realize that the parts are normal, but that the position has changed. Normal robots will not realize this, because they have been programmed to accept the parts in only one position, and as a result, they may discard perfectly good parts.

However, an intelligent machine will recognize that there is nothing wrong with the parts, only in the position. It will not reject the parts but will make an intelligent decision on its own.

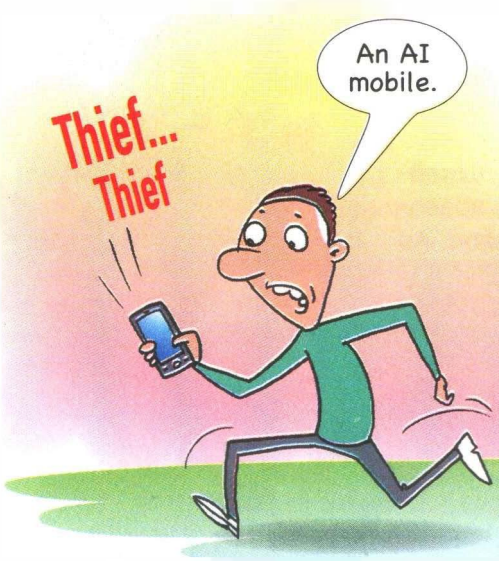
How does AI work?

A robot computer that has Artificial Intelligence first gathers all the facts about a situation, either through sensors, or by human input.

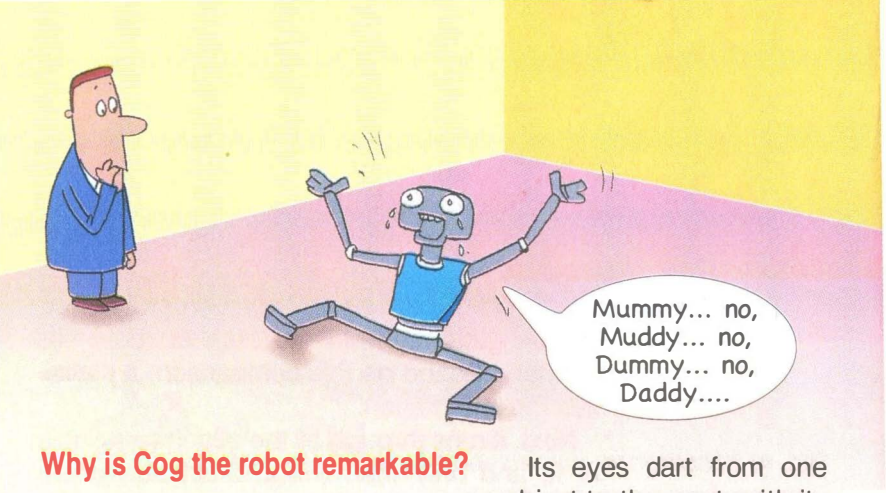
During the next step, it compares the information gathered with the data stored in its memory. Based on this comparison, it classifies the information.

Next, it runs through all the options available to it, and only then will it decide on which option will yield the best result. The important point is that machines with AI can only find solutions to problems based on the inputs and data that have been fed to them.

On 11th May 1997, a chess playing computer called Deep Blue beat the then world chess champion Garry Kasparov in a game.



However, if the same computer was asked the simple question 'Do you like chess?' it would not be able to answer. This is because it has not been programmed to answer this particular question. It can only decide on complicated chess moves!



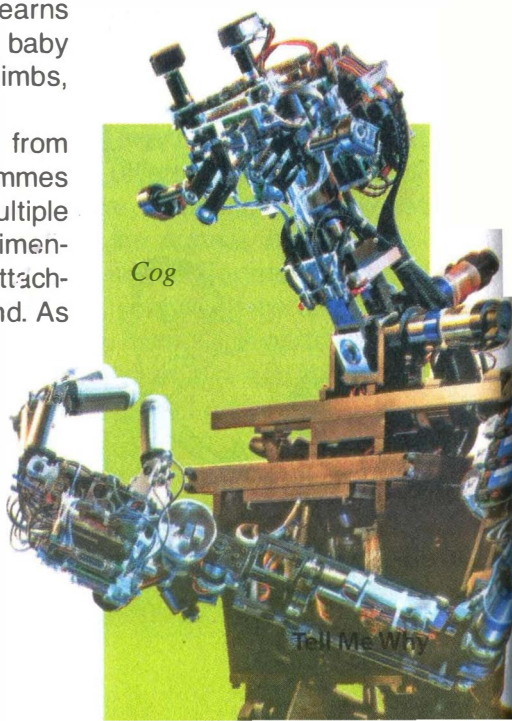
Why is Cog the robot remarkable?

Cog the robot was created with the idea of building a robot with human intelligence.

Cog is remarkable in that it learns things just like a new born baby does, from co-ordinating its limbs, to exploring its environment.

Cog's intelligence comes from many small computer programmes working together. It uses multiple video cameras for three dimensional vision, and has an attachment that can work like a hand. As a result of all these innovations, Cog can pinpoint the source of a noise, make eye contact with humans, and can even interact with objects and track a moving one.

Its eyes dart from one object to the next, with its head slowly bringing up the rear, as though it were human.



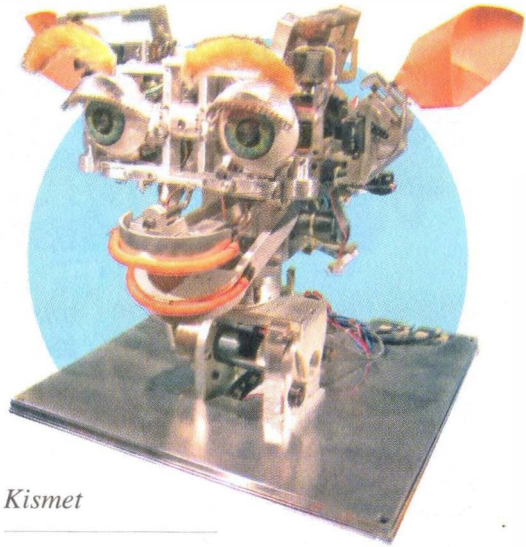
Cog

What is Kismet?

Kismet is also a robot that has been developed at MIT. Cog and Kismet are the first of a new type of robot designed to behave in the same way as small children.

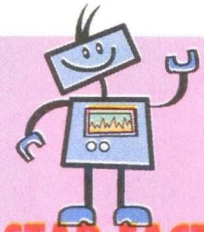
Kismet can recognise human body language and voice inflection and respond accordingly. Its specialty is that instead of directing every action using a central computer, lower-level actions are controlled with lower-level computers.

Kismet may be just a head, but it has more interesting facial features than Cog, making its moods easier to interpret.



Kismet

Complete with eyelids, ears and newly acquired lips, Kismet has the appearance of something young and cute, and reacts to events with an impressive repertoire of doe-eyed expressions ranging from surprise and interest, to sadness and anxiety.



STAR FACT

Mighty Mouse

In 1938, Claude Shannon invented an electro- mechanical mouse. It had the capacity to find its way to a particular point in a maze by a process of trial and error.

APPLICATIONS IN INDUSTRIES

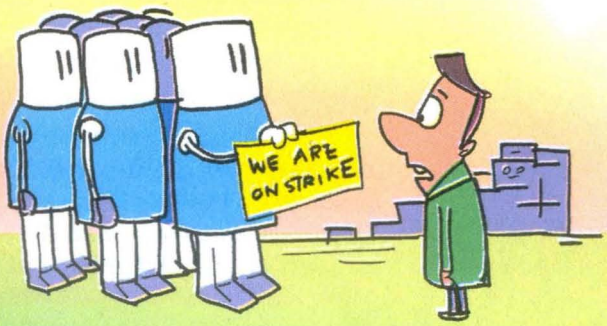
What is the role of robots in industries?

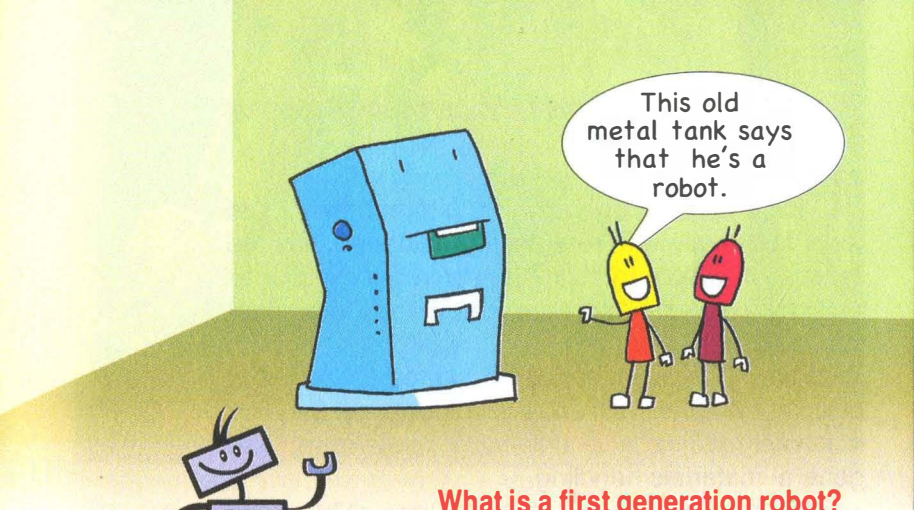
Robots can be found in auto, medical, manufacturing, and space industries. In fact, there are over a million of these robots working for us.

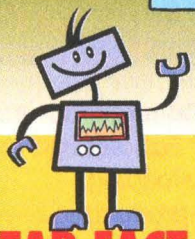
Robots can work for 24 hours a day for years. Though robots are reprogrammable, in many applications, they are programmed once, and then, they will repeat that exact same task for years. Industrial robots offer numerous advantages over manual industrial labour or fixed automation.

They are faster, more efficient, and can function well even in harsh environments. The very first industrial robot, introduced in 1937, was a crane like device that could stack wooden blocks in a programmed pattern.

Industrial robots have come a long way since then, and today, they are not only highly sophisticated, but intelligent too.







STAR FACT

Robot Population

The robot population of the world is increasing rapidly. Japan has the most number of robots- nearly 40 percent of the total. Half the robots in the world are in Asia, 32 percent in Europe, 16 percent in North America, and 1 percent each in Australasia and Africa.

What is a first generation robot?

The very first robots designed for use in industry were not as sophisticated as the later ones. They are known as first generation robots.

These robots are large, heavy machines used for work such as handling hot pieces of metal, loading, welding car bodies, and spray painting.

They generally have a special tool, such as a gripper or welding gun, fixed to the end of their arms. These machines have the ability to make precise motions at high speed, many times, for a long time. Such robots find widespread industrial use today.

First-generation robots can work in groups, if their actions are synchronised.

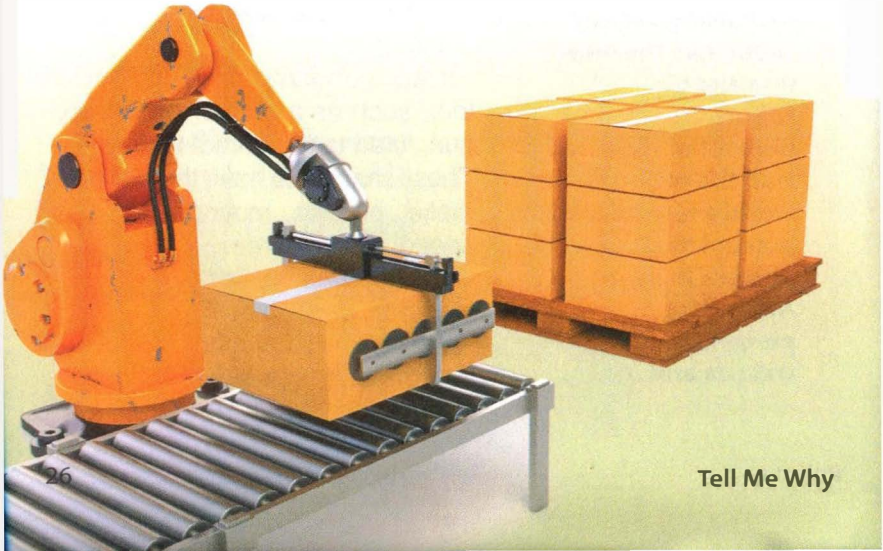
Why are industrial robots considered ideal for pick and place operations?

'Pick and place operation,' is a term that is used most frequently with reference to factories. It is the process in which an object is required to be picked up from a specified position, and placed in another particular position.

Some robots are specially designed for pick and place operations. Pick and place robots are used for machine loading and unloading, pelletizing, and general materials handling.

For example, in a soft drink factory, robots take drink cartons from the end of a conveyor belt and place them into boxes, or for loading and unloading.

High-speed pick and place robots take products from one location to another with pinpoint accuracy, and are more efficient than humans in doing such jobs. At the same time they help in reducing production costs too.



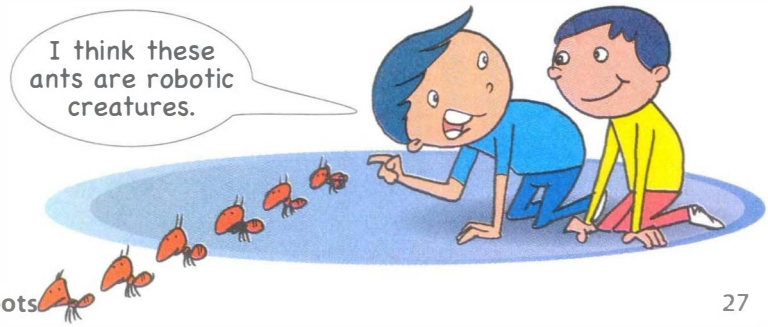
Why are robots good in point-to-point operations?

Point-to-point control of a robot means that individual robot positions are recorded in the memory of its computer.

Like the pick and place robots, robots performing point-to-point operations must go from one point to the other, to get the desired accuracy.

With point-to-point control, the robot records the point where it picks up a part, and the point where it releases that part. The robot then determines the best path to take between the two points.

The point-to-point system is used when the same task has to be repeated continuously, or when the path between the two points does not matter. Point-to-point control systems work well in loading and unloading applications.



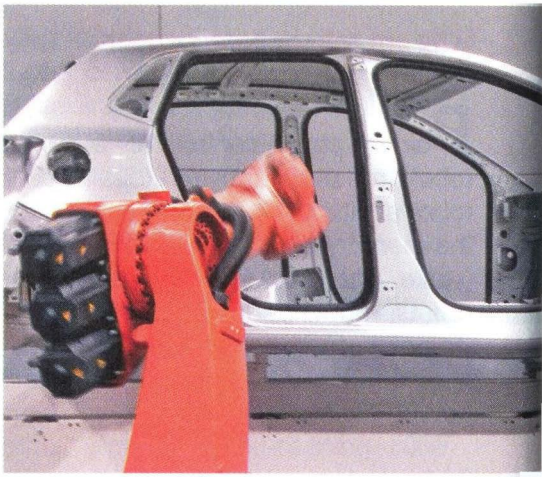
What are continuous path robots?

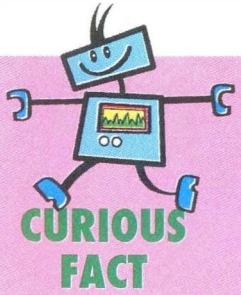
A continuous path control system is one in which the robot is programmed to follow an irregular path exactly.

Inside the control system, the path to be travelled is represented by a large number of points, placed very close to one another.

These points are stored in the robot's memory. The robot, when it is working, follows the points to reproduce the desired path. Such robots are very useful in jobs like spray painting.

The painting is not expected to be done continuously along the wall from one corner to the other, since no paint is to be applied to the doors and windows. At the same time, in order to apply a uniform coat of paint on the wall, the robot has to move with a constant velocity. Such robots are used widely in industry, and are called continuous path robots.





Shakey

Shakey is the name of a robot which was developed between 1966 and 1972 in the USA. It was one of the first robots to move freely on its own.

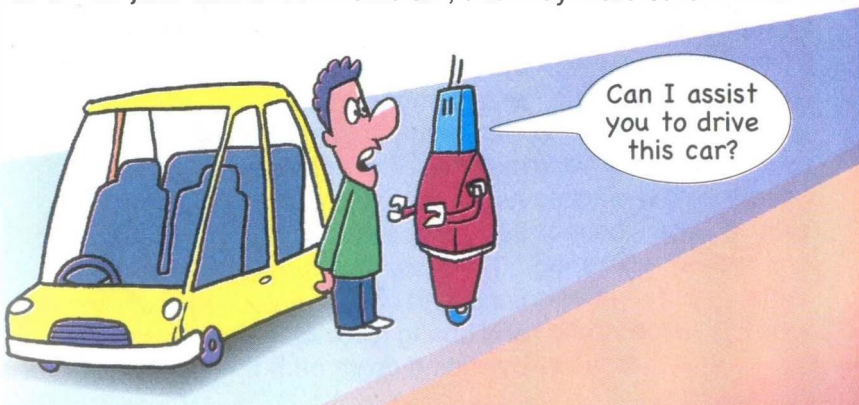
How are robots useful in the automobile industry?

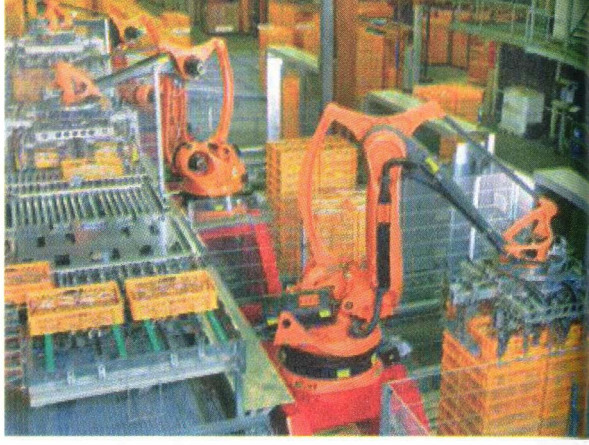
The first robot made its debut in the 1960s. It was called the Unimate, and it was a robot working in the automobile industry.

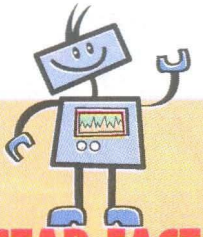
Since then, robots have played an increasingly important role in the manufacture of automobiles. As a car is built, it moves along a production line stopping at different stations for different types of jobs to be done.

By the 1980s, robots began to perform many of these jobs like welding, along with painting, and other assembly applications.

Manufacturers found out three things about robots at that time – they were cost effective, they were efficient, and they were safe.







STAR FACT

Booming Industry

Robot manufacturing is a booming industry today. In 2014, 200,000 industrial robots were sold worldwide. By the end of 2017, it is estimated that there will be 2 million robots in the world.

What is the role of assembly robots in factories?

A robot that selects, positions, fits, and assembles components and adjusts the finished product according to specifications, is known as an assembly robot.

Such robots are ideal for use in the assembly line of factories. How does the robot select the correct part? It uses a TV camera to capture a picture of the different components, and compares it with the picture already stored in its computer's memory.

It then chooses the component that matches the picture in its memory. Assembly robots have expanded production capacity in the manufacturing world.

They can be used for different applications, and can save workers from tedious and boring jobs, as well as save on costs by cutting down on human error.

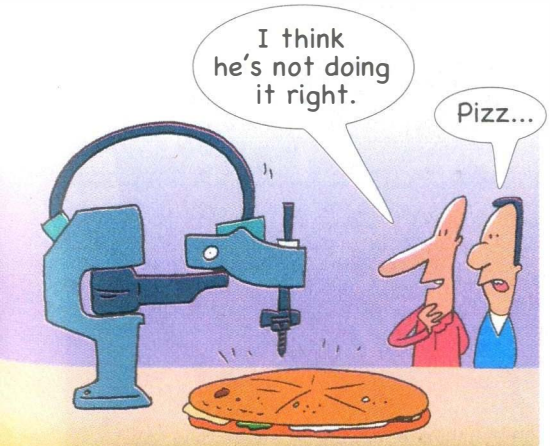
Why is SCARA the robot a success?

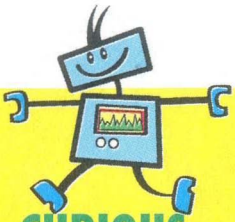
The name SCARA stands for Selective Compliance Assembly Robot Arm, or Selective Compliance Articulated Robot Arm.

It represents a completely new concept for assembly line robots. This robot was developed at the University of Yamanashi under a team led by Professor Hiroshi Makino in 1981.

An important feature of this robot is that it has a jointed arm that can move in two dimensions. It is a two jointed arm- a little similar to a human arm- and this feature allows it to reach into confined areas, and then fold up out of the way.

SCARA is especially useful in loading and unloading processes within closed spaces, and is also generally faster and cleaner than other comparable robot systems.





CURIOUS FACT

Robot Cops

Before long, there will be robot cops patrolling the streets, and handing out parking tickets. These robot cops are being developed by Florida International University's Discovery Lab.

What are delta robots?

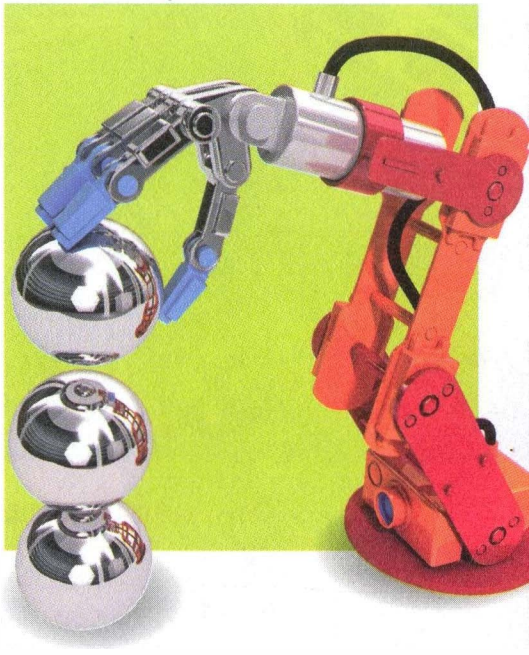
A delta robot consists of three arms connected to universal joints at the base.

It was invented in the early 1980s by a research team led by Professor Reymond Clavel at the Ecole Polytechnique Federale de Lausanne, Switzerland. The purpose of this new type of robot was to manipulate light and small objects at a very high speed.

Delta robots have popular usage in picking and packaging in factories because they can be quite fast, some executing up to 300 picks per minute. Industries that take advantage of the high speed of delta robots are the packaging industry, medical and pharmaceutical industry.

They are also used for surgery. Other applications include high precision assembly operations for electronic components.

Moreover, tasks such as in solar cell, or other small part assembly, can be completed quickly and perfectly every time with delta robots.



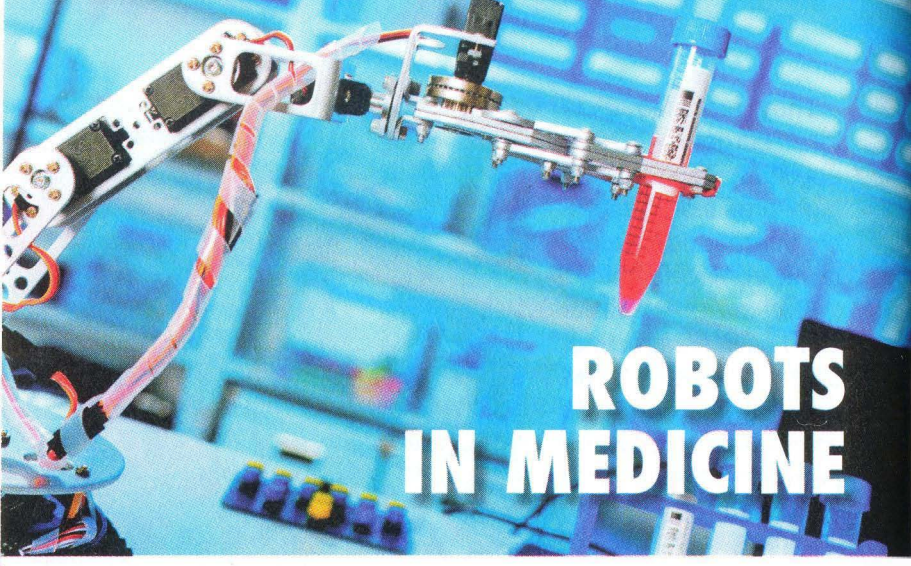
What are the advantages of using robots in industries?

Robots can improve productivity in industry dramatically, since they can work for 24 hours a day, without taking a break. Moreover, robots work much faster, which means more units can be produced.

At the same time, costs are cut. Once the company pays for the robot, it does not have to pay a salary to workers to do the same job. It only has maintenance costs for the robot. The use of robots in industry also ensures better quality products.

This is because robots are more precise than human beings, and they do not get tired, and make mistakes. It is also much safer to use robots rather than people for some jobs, like unloading of hot furnaces, or handling of radioactive chemicals.

In addition, robots are more obedient than human beings, and will not strike work or argue.



ROBOTS IN MEDICINE

What are medical robots?

Today, medical robots are transforming the face of healthcare. They are being increasingly used in medicine, from tiny robots used in various operations, such as removing plaque from a patient's arteries, to robots that help with disease screenings.

A medical robot is one that allows surgeons to operate even the delicate organs, more easily, and more precisely. This is especially true in eye and brain surgery, where accuracy, delicacy and microscopic adjustments are necessary.

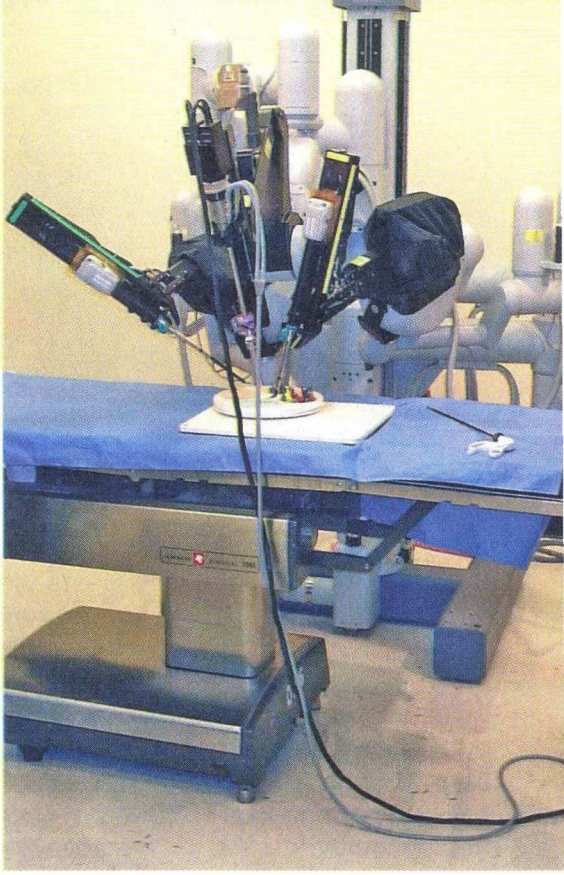
Medical robots can work hours without a break, without getting fatigued, or making a mistake. In fact, they have proved to be the ideal assistants for surgeons. Robots have also played an important role in the design and fitting of artificial limbs.

What is the da Vinci Surgical System?

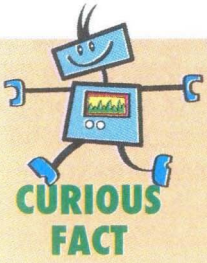
Surgical robotics came into the limelight in 1999 when an American company called Intuitive Surgical introduced the da Vinci Surgical System.

It is a robotic surgical system designed to help surgeons perform surgeries with just a few small incisions. The system uses the latest in surgical and robotic techniques in both routine and complex surgeries.

The da Vinci Surgical System translates a surgeon's hand

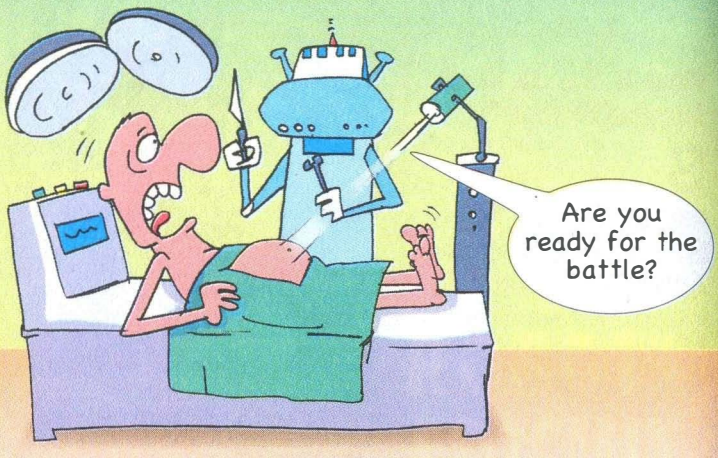


The da Vinci Surgical System



ROBODOC

ROBODOC is one of the first robot surgeons. It is a hip surgery robot, and has effectively performed part of a hip surgery.



movements into smaller, more precise movements, through tiny instruments that are placed inside the body.

The surgeon carries out the procedure from a console, and has 100 per cent control throughout the surgery.

The system has been successfully used all over the world in hundreds of thousands of surgical procedures so far. It is especially beneficial for cardiac valve repair, and has changed the concept of surgery.

What are the advantages of robotic surgery?

Robotic surgeries have many advantages over traditional methods of surgeries. To begin with, they are more precise. Only smaller incisions have to be made- so there is less loss of blood, and less pain from the patient's point of view.

Because the wounds are smaller, they heal faster, and consequently, the duration of the stay in the hospital is shorter.

On the other hand, traditional open methods of surgery involve long recovery time, long hours of operation, blood loss, surgical scars and marks and limited access to surgical area.

The end result is that robotic surgeries will be cheaper and safer than traditional surgeries.

Why are robots useful in rehabilitation?

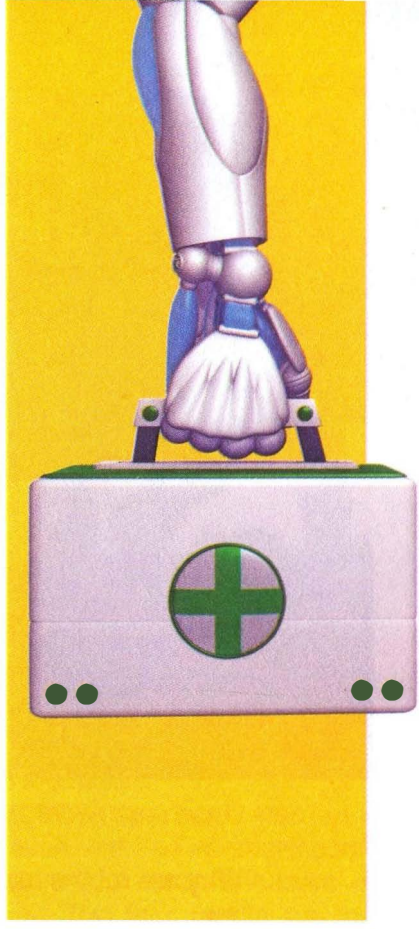
Robots can be very helpful in the rehabilitation of people with physical disabilities, and in helping the elderly.

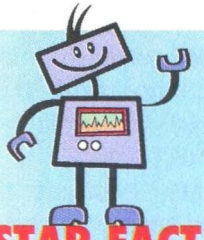
Rehabilitation robotics was introduced two decades ago for patients who have neurological disorders.

Robots have been designed to help improve limb function after a stroke, to help people walk, and to assist in many other areas of rehabilitation.

Robotic rehabilitation therapy can deliver high-dosage and high-intensity training, making it especially useful for patients with motor disorders caused by stroke or spinal cord disease.

Robotic technology has developed remarkably in recent years.





STAR FACT

HelpMate

HelpMate is a robot that acts as a helper in hospitals. It carries meals for patients, and takes specimens and records from one part of the hospital to another.

ROBOTS IN SPACE

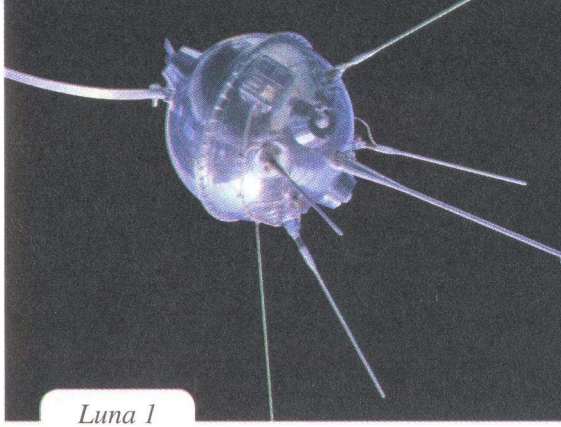
ATHLETE- Robotic Lunar Rover

Why are robots useful in space?

Robots are especially valuable to space exploration. Space is an environment that is hostile to humans. There is no air to breathe, and no atmosphere to protect people from extreme heat, cold, or harmful rays. This is where robots are very useful.

Robots are cheaper to operate, because they require no life-support system, and can be left behind after the mission. Everything they have found can be sent back to Earth, by radio.

Before astronauts were sent to the Moon, a series of Surveyor spacecraft soft-landed on the lunar surface between 1966 and 1968. Surveyors transmitted thousands of images back to Earth, and analysed solid samples gathered with an extendible claw.



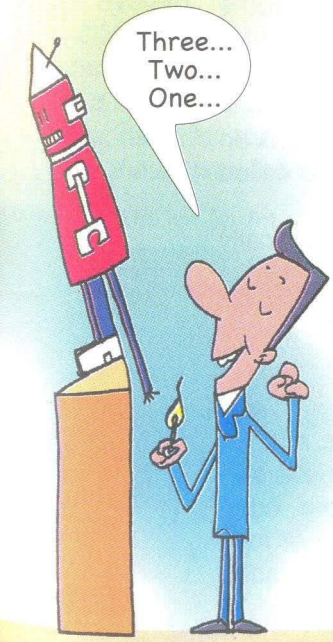
Luna 1

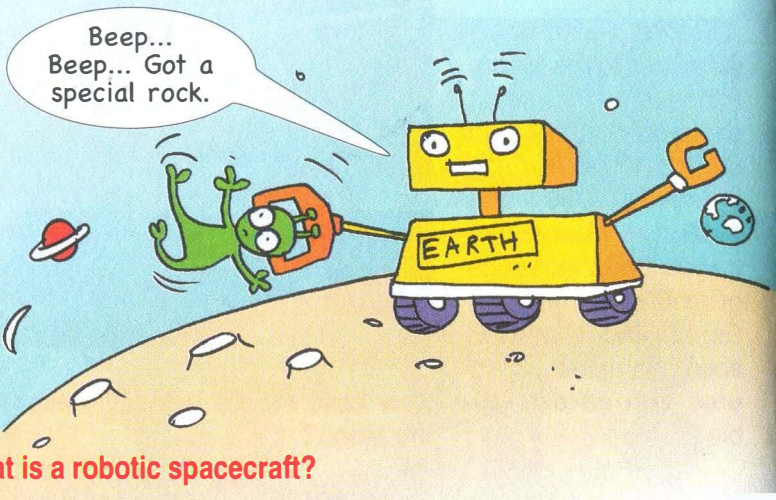
How have robots helped in exploring the Moon?

The first lunar exploration vehicles of the 1950s were primitive pioneers. In January 1959, a small Soviet sphere bristling with antennas, dubbed Luna 1, flew by the Moon at a distance of some 5,900 kilometres, but did not touch the surface of the Moon.

This unmanned spacecraft was not a robot, as such, but had on board computers that gave it some measure of self control. The first robots on the Moon were sent by the Soviet Union which successfully landed two robotic rover vehicles in the early 1970s. The robots were called Lunokhod, and were a part of Russia's Luna programme for exploring the Moon.

These robots took thousands of photographs from hundreds of samples, which were sent back to Earth.





What is a robotic spacecraft?

A manned mission to another planet is still some time away- and some planets are too hostile for humans to land on, and explore.

In such cases, a robotic spacecraft is used. A robotic spacecraft is one which has no humans on board, but is controlled robotically. It is also called a space probe.

Each robotic spacecraft is designed specifically for its mission, whether it is intended to go into orbit around its target, or land on the surface.

The advantages of using robotic spacecraft are that they are less expensive, and less risky than a manned mission.

They can collect close up data on planets, moons, asteroids and comets, drill beneath a planet's surface, or take radar measurements from orbit. Robotic spacecraft have brought samples of rock from the Moon, dust from a comet, and the solar wind back to Earth.

Which are the two types of robots used in space exploration?

Two types of robots are used for space missions. They are known as ROV and RMS.

ROV stands for Remotely Operated Vehicle. It can be an unmanned space vehicle that orbits a planet, or one that lands on it.

Some of those that land operate from a stationary position, while others move around the terrain. RMS stands for Remote Manipulator System.

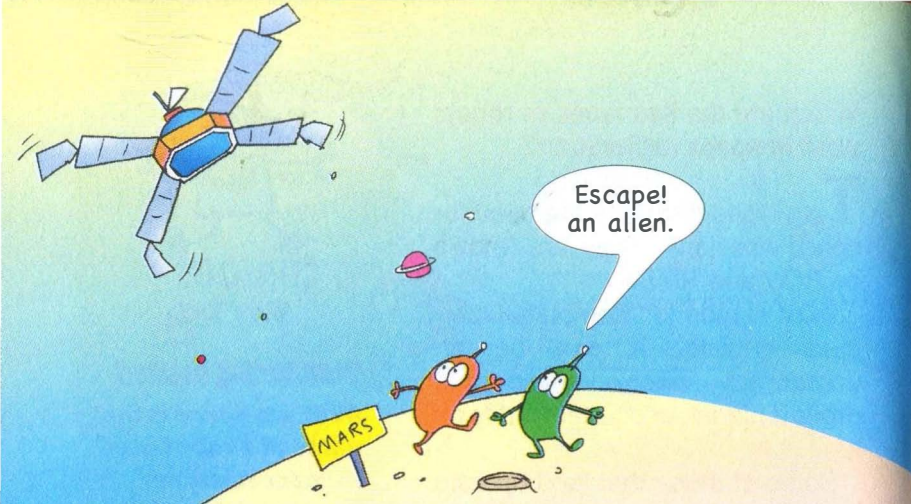
It is a crane-like device or robotic arm which can serve as a grappler, or a remote assembly device. It is also used to position and anchor astronauts working in space.

CURIOUS FACT

Wandering Around

AERCam Sprint is the name of a robot used in space missions. Its shape is like that of a beach ball, and it zooms around outside a space shuttle, sending images back to the astronauts inside the shuttle.

AERCam Sprint



Which are the famous space robots?

Space robots have played an important role in space missions, especially in those to the planet Mars.

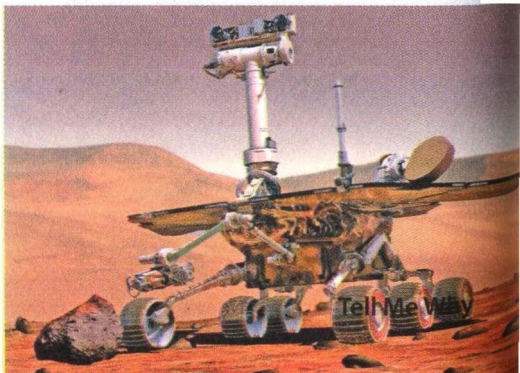
Some of them have circled the planet, others have landed on it. The Russians were the first to use space robots. The most famous robots in space are the series of orbiters, rovers, and landers that have been sent to Mars.

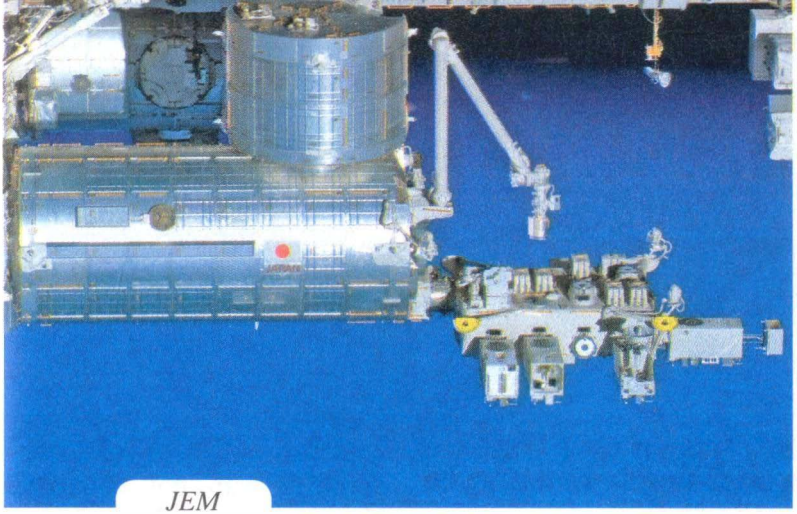
The first orbiter was the Mariner 4, which flew past Mars on July 14th, 1965, and took the first close up photos of the planet.

The Russians landed Venera 7 on Venus. It was the first Man-made vehicle to successfully land on another planet, and to transmit data back to Earth.

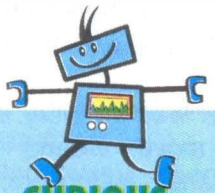
Nanokhod is the robotic rover used by European Space Agency which is famous for its amazingly small size.

Mars Exploration Rover





JEM



CURIOUS FACT

Venera

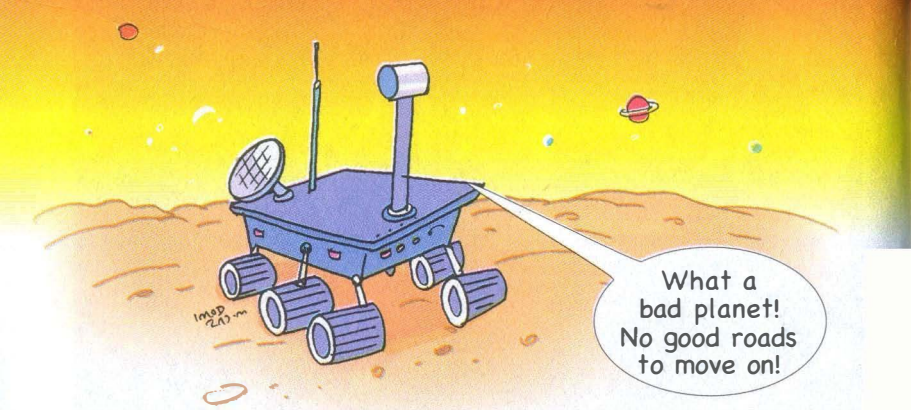
The Soviet space mission to Venus is known as Venera. In 1970, Venera 7 made history when it became the first space robot to transmit data from another planet.

Which Asian countries have pioneered robots in space?

India, China, and Japan in Asia have conducted robotic experiments in space. Japan has a research facility, named the Japanese Experimental Module or JEM, which is attached to the Kibo module on the International Space Station.

It has two robotic arms - one small fine arm, and another large arm, which help JEM to carry out experiments without the astronauts leaving the station.

Two of the ground-breaking events in space exploration recently were the December 2013 landing of China's Chang'e-3 spacecraft, and Yutu rover on the surface of the Moon, and the Indian Mars Orbiter Mission's successful insertion into orbit around the Red Planet, on September 24, 2014.

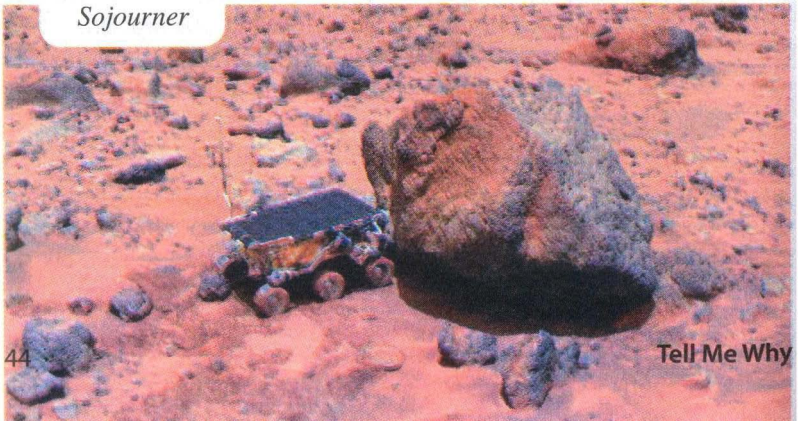


Why was the Mars Sojourner a great step forward in space exploration?

On 4th July 1997, the Mars Pathfinder sent by NASA landed on Mars. After the Mars Pathfinder landed, it began a successful mission exploring Mars with on-board instruments, and the robot Sojourner rover.

Sojourner marked an important step forward in space exploration for several reasons. It was not controlled directly from Earth. Rather, it sent its signals to the Pathfinder, which then relayed the signals to Earth.

Sojourner was the very first robot to move around on another planet, taking photographs, and studying the soil. Its first task was analysing the composition of 'Barnacle Bill', a rock just a little way away from the landing site.


Sojourner

Underwater Vehicle Black Ghost

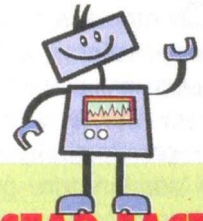
Why are robots useful for underwater exploration?

Scientists worldwide are designing and deploying robots for underwater exploration.

Underwater swarming robots called coralbots are used to repair damaged coral reefs. RoboJelly is a robot modelled after the jellyfish, and is designed to run on hydrogen. Once deployed in the oceans, RoboJelly would have a limitless fuel supply, and could perform a range of functions, including monitoring water quality, and mapping the oceans.

Other robots like Deep Drones can travel to the ocean floor, and help recover crashed aircrafts and sunken ships.

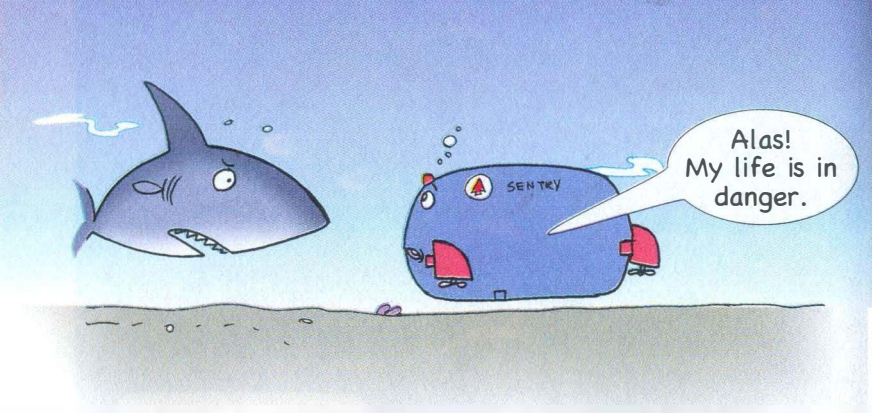
The advantages of using underwater robots is that they can move faster, dive forty times deeper, and travel greater distances at a time than regular divers.



STAR FACT

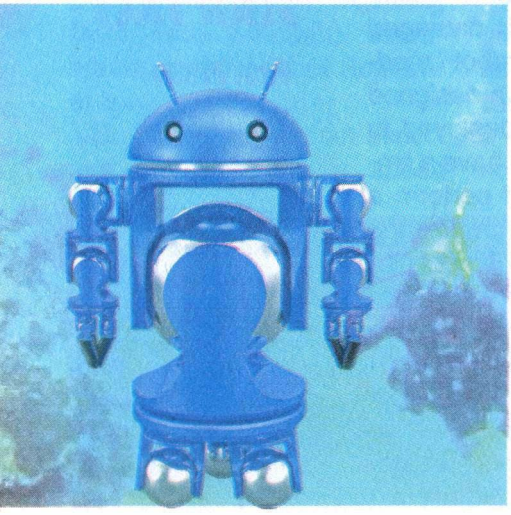
First Probe

Viking 1 was the very first probe to land on Mars. It had a telescopic robotic arm fitted with a small scoop to enable it to collect soil and rock samples.



What is Sentry the robot?

Sentry is a new state of the art underwater robot. It was developed by scientists and engineers from the Woods Hole Oceanographic Institute and the University of Washington.



Sentry is an AUV, or Autonomous Underwater Vehicle. Sentry has several advantages when it comes to exploring the ocean floor.

It can operate independently without tethers or other connections to a research ship, and is preprogrammed with guidance for deep water surveying.

It can also make its own decisions about navigating the mountainous volcanic terrain of the seafloor.

In addition, Sentry is capable of diving as deep as 5000 metres, and can survey huge areas of undersea territory on dives lasting a day or more.

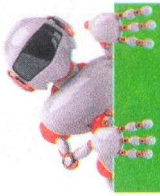
Which are some of the famous robots used for exploring?

Robots can explore places that are dangerous for humans, like the inside of volcanoes, burning deserts, or icy wastelands.

Dante II and Nomad are two such famous robots. Dante II is an eight-legged robot designed to walk, spider-like, into live volcanoes, looking for clues as to whether an eruption is likely. It can climb down into the interior of a volcano, take photos with its eight cameras, and collect gas samples.

On the other hand, Nomad is a self-guiding robotic vehicle that wanders the frozen Antarctic in search of meteorites. The four-wheeled gasoline-powered Nomad cruises autonomously, navigating with the help of laser range-finders that make a map of the surrounding terrain.

Nomad

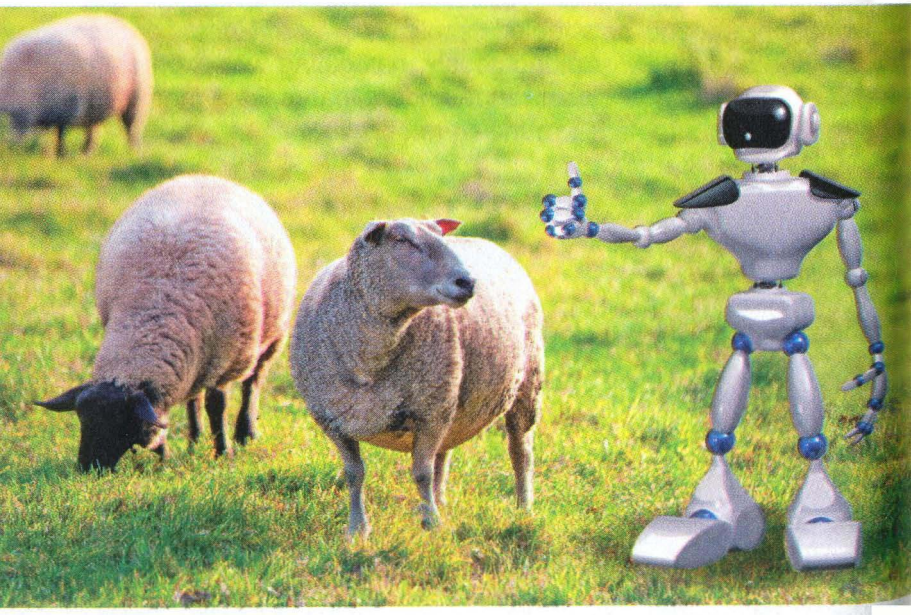


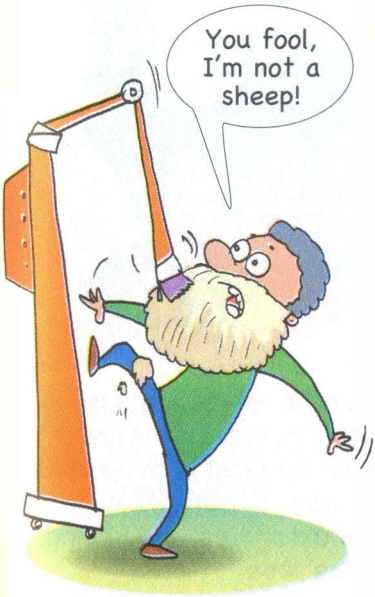
ROBOTS IN DAILY LIFE

How do robots help Australian sheep farmers?

Sheep farming plays a key role in the Australian economy and the Australian way of life. Shearing the sheep, or cutting off its wool, is a painstaking process.

However, robots have now taken over this job to the relief of many sheep farmers. An electric clipper is carried by the robot arm, and it shears the wool.





Sensors on the clipper determine the distance to the skin of the sheep within an accuracy of 0.005 inch. This means that the chance of injuring the sheep is drastically reduced.

If the animal moves, the robot will move with it, and the robot can perform this task all day without getting fatigued, which is another great advantage.

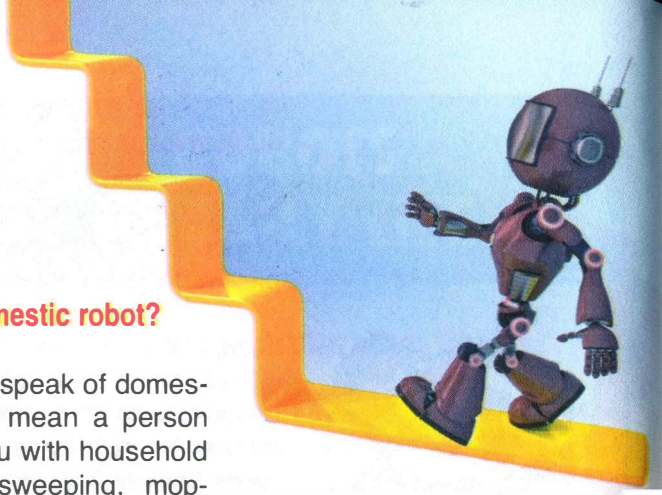
Why are robots useful in places like nuclear labs and mines?

Some jobs involve a lot of risk to the people doing them. For example, working in a nuclear lab, power plant or a mine, is a dangerous occupation.

Radioactive materials are handled continuously in nuclear labs, and this can be quite hazardous, as everyone knows. Therefore, robots are increasingly being used in nuclear power plants, especially in clean up operations after a nuclear accident, or in disposing of toxic nuclear waste.

The same is true of the mining industry, where workers daily face the risk of mines flooding, collapsing, or releasing toxic gases. It is much better to use robots, than expose workers to such dangers.

Robots can also play an important role in rescue operations after a mine disaster.



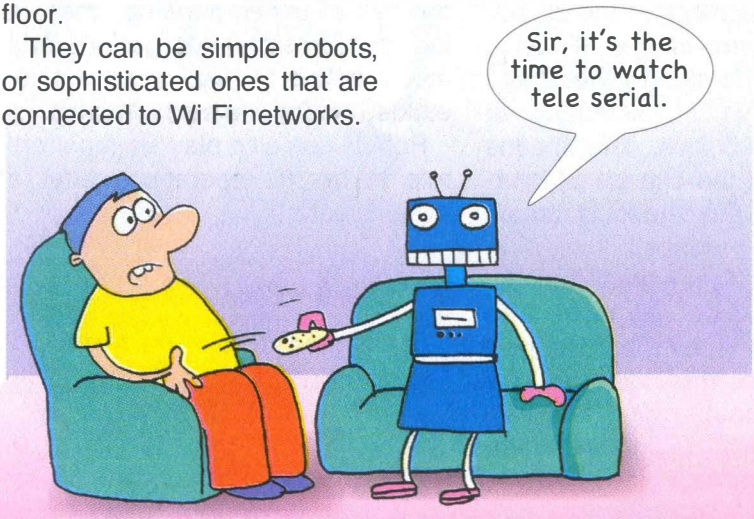
What is a domestic robot?

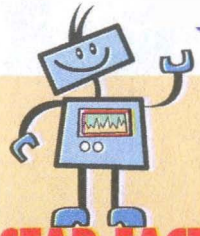
When you speak of domestic help, you mean a person who helps you with household chores like sweeping, mopping the floors, or washing dishes.

Similarly, domestic robots are robots that are used for housework. These robots can do tasks like vacuum cleaning, and scrubbing or mopping the floor.

They can be simple robots, or sophisticated ones that are connected to Wi Fi networks.

Domestic robots are not yet very common, but in the future, they will be used in more and more homes, simplifying the household chores, and freeing up users' time.

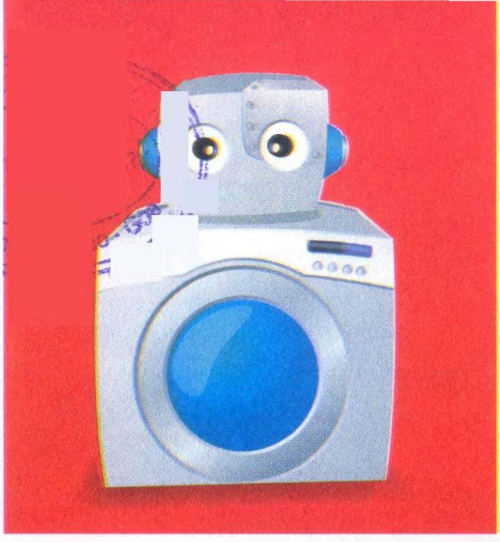




STAR FACT

Packabot

When the World Trade Centre collapsed in 2001, a robot played a very important part in the rescue operations. This rescue robot named Packabot could enter areas in the wreckage that were too dangerous for humans. It also helped in searching for, and finding, survivors.



Which are some indoor domestic robots?

There are different types of indoor domestic robots presently in use.

Some of them vacuum clean the house; others can wash and scrub floors, or just mop them clean. Robots can help in the kitchen too.

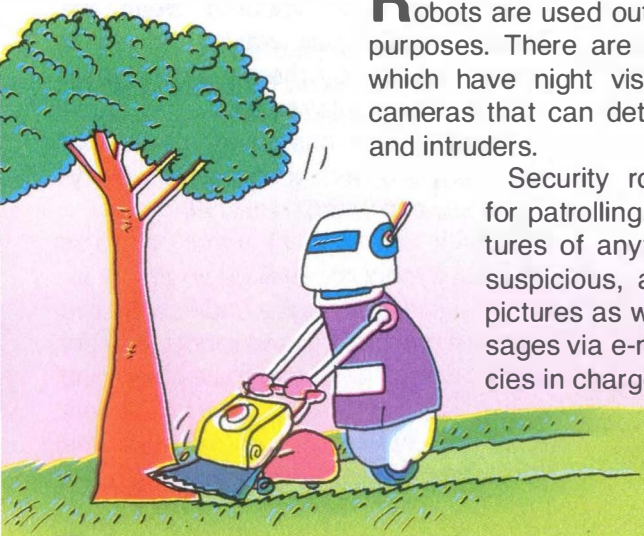
Scientists are designing robots that are capable of slicing vegetables, carrying trays, and washing dishes.

If there are pets at home, there is already a robot that will clean up cat litter. The possibilities are endless. Before long, we can hope to see robots in every home, cleaning, cooking, washing and drying, so that homemakers can take it easy and devote their energy and time in search of more rewarding goals.

What are outdoor robots?

Robots are used outdoors for many purposes. There are security robots, which have night vision wide angle cameras that can detect movements and intruders.

Security robots are used for patrolling. They take pictures of anything that looks suspicious, and send these pictures as well as text messages via e-mail to the agencies in charge of security.



Then there are robots that can mow the lawn without anyone driving them. Other robots are used for cleaning pools, while still others can do jobs such as washing windows and cleaning gutters.

CURIOUS FACT

Trilobite

Trilobite is a robot that was launched in 2001. It works like a vacuum cleaner, but is more intelligent. It can clean for an hour, and when its batteries run low, it will go and recharge itself without any help from humans.

Why are toy robots popular?

Robot toys can be educational and fun too, and are therefore, popular with both children and their parents.

Furby is a robot toy that resembles a hamster or an owl. These owl-like robotic toys started out speaking 'Furbish,' the unique language that all Furbies use. But over time they learned bits of English.

Then Sony introduced the robotic pet called AIBO which also proved to be tremendously popular. Other robotic dogs also came into the market, along with cute robotic seals.

There are robots that play games like Romo, which is a small robot that employs smartphones as its brain. Romo can be driven, and can perform simple tasks, like being your roaming photographer or videographer.

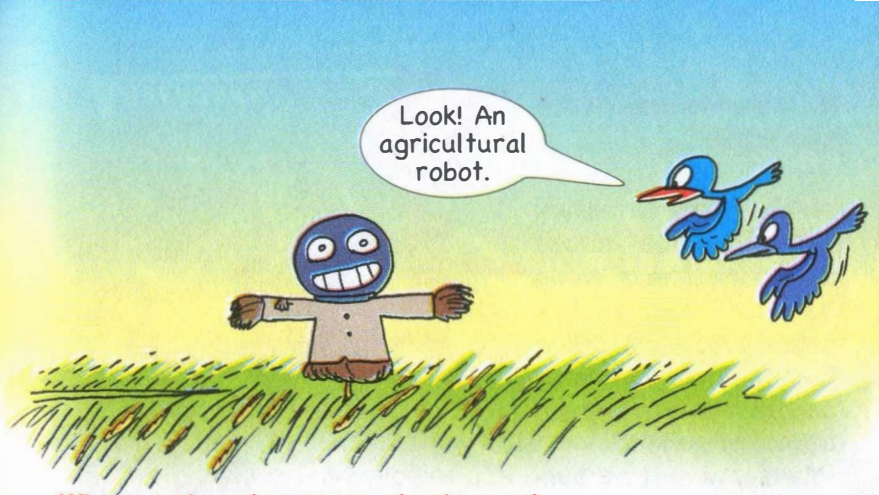
What are social robots and telepresence robots?

Social robots are robots that helps in social interaction. They can be designed for different purposes- whether it is to encourage and teach social behaviour to children with autism, or to help stroke patients with their physical rehabilitation exercises.

A telepresence robot is a remote-controlled, wheeled device with a display. These robots can move around in a remote location, and let one communicate with people there via its camera, speaker, and microphone.

Telepresence robots are typically much more affordable than the travel costs or fees they might replace. They also enable much more interactivity than regular video chat.

Today, there are also telepresence robots designed for in-home uses, such as watching over children, or elderly people.



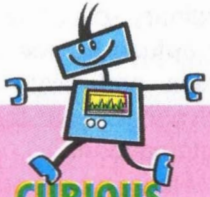
What are the advantages of using agricultural robots?

Today, there are many robots that are designed for specific agricultural tasks.

Robots are being used for driving tractors, sorting potatoes, spreading fertilizers, pruning, mowing, thinning, harvesting, picking fruits, milking cows, shearing sheep, and many other jobs.

These robots are being used more and more by farmers as they have many advantages. They can cut down production costs, reduce monotonous tasks, and increase productivity.

In recent years, great investments were made to develop intelligent robots that require little human input during operations. These machines are designed to replace humans in heavy work on the field, or in tasks that require repetitive actions.



CURIOUS FACT

Robot and Frank

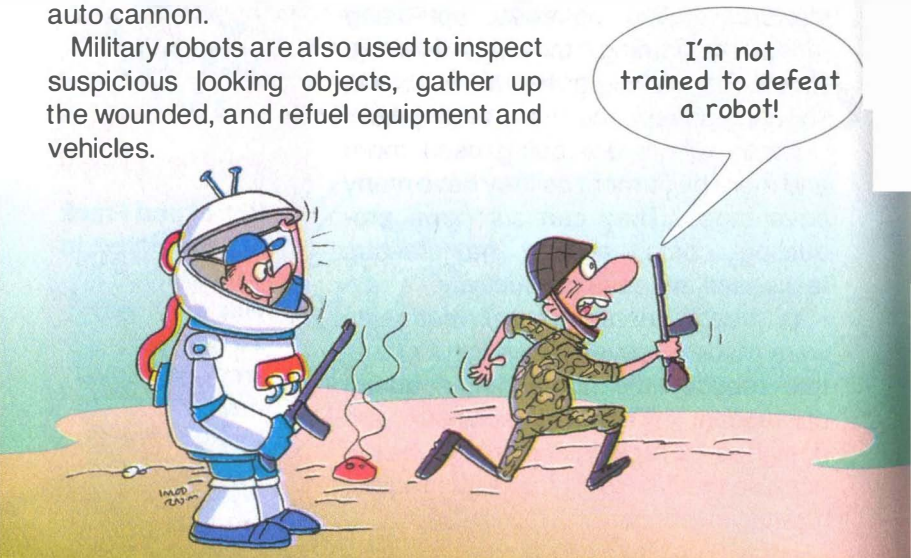
Robot and Frank are characters in a movie that was released in 2012. It is the story of an old man who is looked after by a robot.

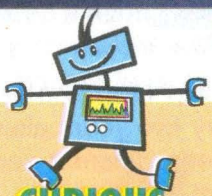
What are the uses of military robots?

The history of military robots can be traced back to the time of World War II. The use of a mobile land mine called Goliath by Germany, marked a turning point in their development.

Today, almost all military organizations use military robots to carry out jobs that are too risky for the ordinary soldier. Military robots are used to defuse bombs, as well as to defend ships and protect airfields using an advanced radar tracking system and an auto cannon.

Military robots are also used to inspect suspicious looking objects, gather up the wounded, and refuel equipment and vehicles.





CURIOUS FACT

Wakamaru

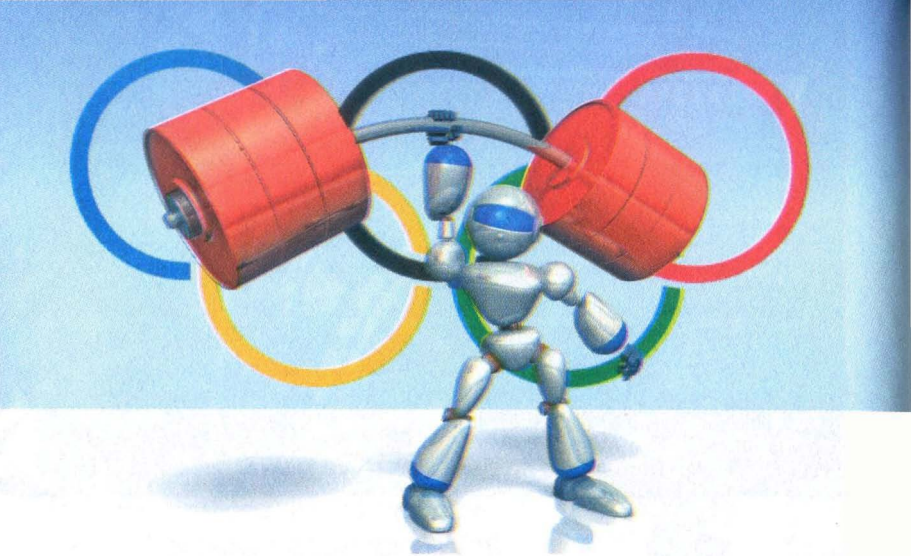
Wakamaru is a talking robot with a vocabulary of 10,000 words. It is designed exclusively to help the elderly. Using a mobile phone and web cam, Wakamaru can take pictures of its owner, and send them to relatives.

Why are spy robots used for?

Spying is an exciting but dangerous occupation. Nations regularly spy on one another, but if a spy is caught, he or she can be imprisoned, tortured, or even killed.

The use of robots for spying is therefore, becoming increasingly popular. A spy robot has a wireless camera fitted on the robot circuit which can catch images and videos, and transmit them to a receiving unit.

During war time, spy robots can help to collect information about enemy terrain and military installations. Information gathered by the spy robot can be used to plan attacks, or improve defences. Spy robots are also useful in tracking terrorists, and preventing terrorist attacks.



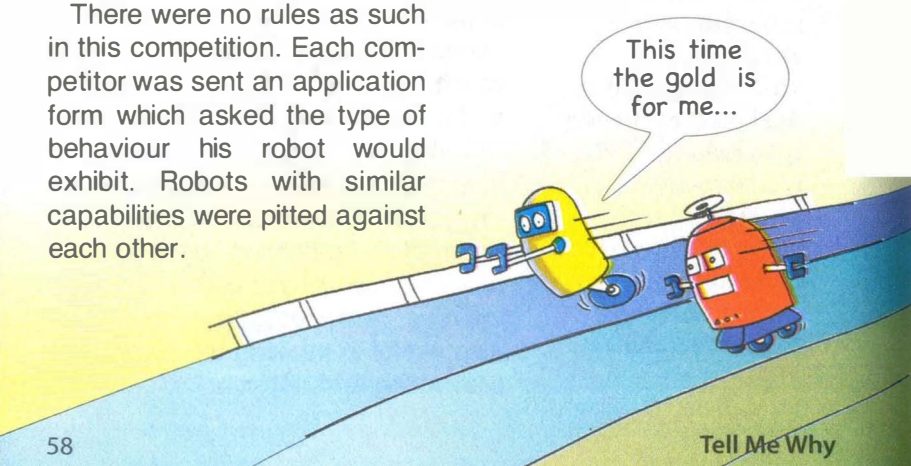
What is the Robotic Olympics?

Robots also have their own Olympics. The first Robotic Olympics, saw robots from over 50 countries participating in events like wall climbing and javelin throw.

There were no rules as such in this competition. Each competitor was sent an application form which asked the type of behaviour his robot would exhibit. Robots with similar capabilities were pitted against each other.

The Robot Olympics will be held every two years alternating between different venues in different countries.

The goal of holding these games is to trigger groundbreaking research in the field of robotics.



HUMANOIDS AND CYBORGS

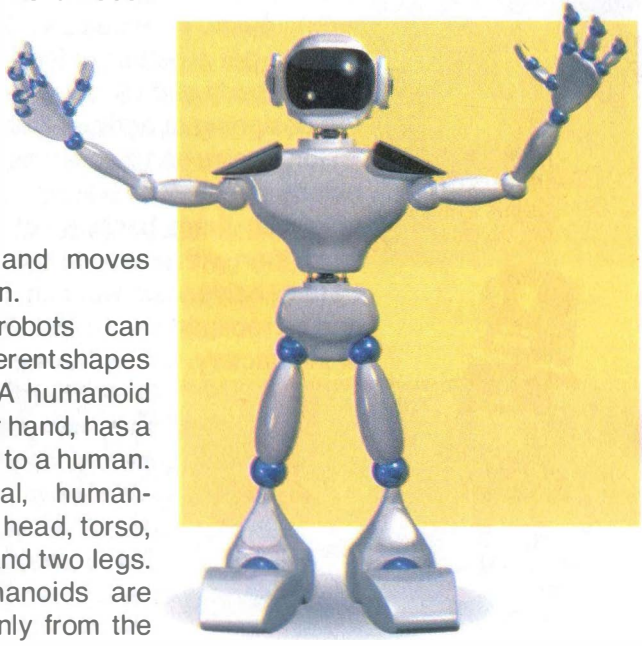
What is the difference between a normal robot and a humanoid?

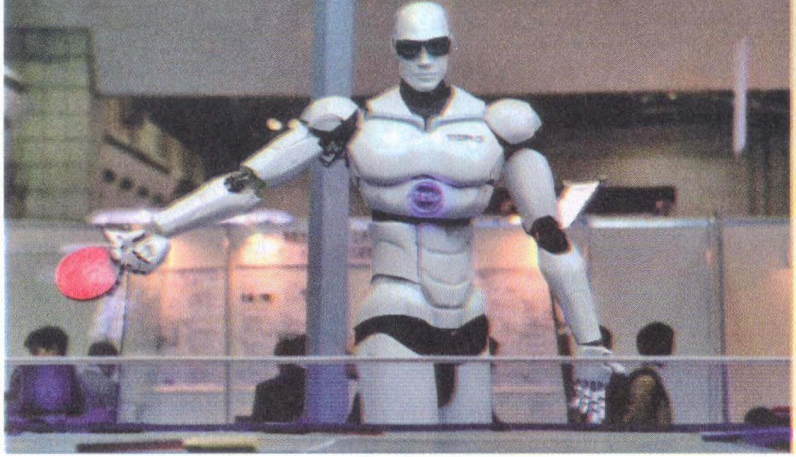
The difference between a normal robot and a humanoid is that a humanoid is a robot that looks and moves like a human.

Normal robots can come in different shapes and sizes. A humanoid on the other hand, has a form similar to a human.

In general, humanoids have a head, torso, two arms, and two legs. Some humanoids are modelled only from the waist upwards, others may have a head with facial features.

Asimo is one of the most popular humanoids launched by Honda in 2000, after years of research. Petman, Nao, and Atlas are other famous humanoids.





Topio- A Humanoid Robot.

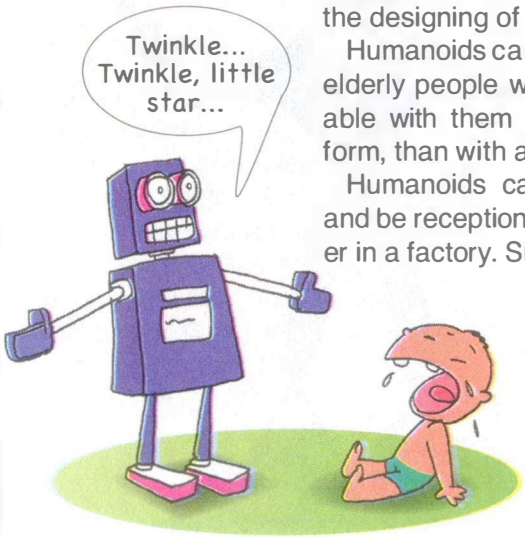
Why are humanoid robots very useful?

Humanoids are extremely useful in different fields of research. They can be used to get a better understanding of the human body and its working-especially in the designing of artificial limbs.

Humanoids can also act as assistants to elderly people who will be more comfortable with them because of their human form, than with a normal robot.

Humanoids can work in regular jobs, and be receptionists in an office or a worker in a factory. Since they can use tools, it is expected that they will soon be operating equipment and vehicles.

Humanoids can be great entertainers too. Some of them can sing, dance, play music, and interact with audiences!



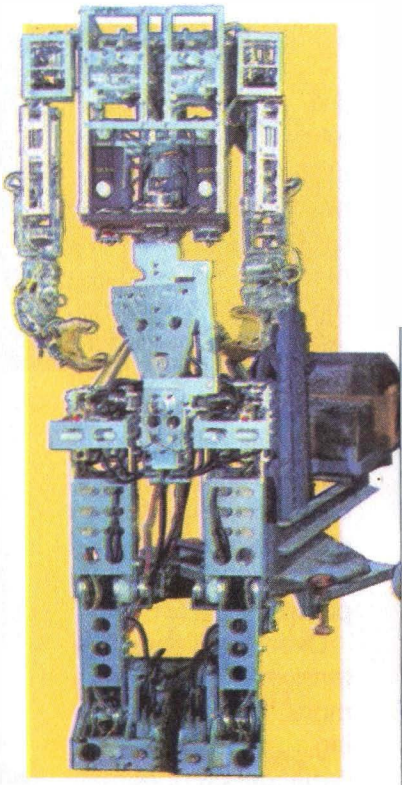
What is WABOT- 1?

The WABOT-1 was the first full-scale humanoid robot developed between 1970 and 1973.

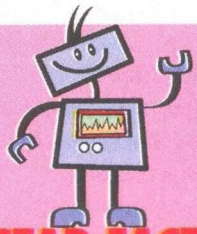
It was a Japanese experimental robot that looked like a human being, with its two legs and two arms. It had sensors all over its body, as well as built-in television cameras, microphones, and loudspeakers. When given a command, it would reply that it understood.

The WABOT-1 was able to communicate with a person in Japanese, and to measure distances and directions to the objects using external receptors, artificial ears and eyes, and an artificial mouth.

It walked with its lower limbs, and was able to grip and transport objects with hands that used tactile-sensors. It was estimated that the WABOT-1 had the mental faculty of a one-and-half-year-old child.



WABOT-1



Largest Robot

Zollner Elektronik AG in Zandt, Germany created the largest walking robot- a fire breathing dragon that is 15.72 m in length, and 12.33 m in width, and 8.20 m in height.

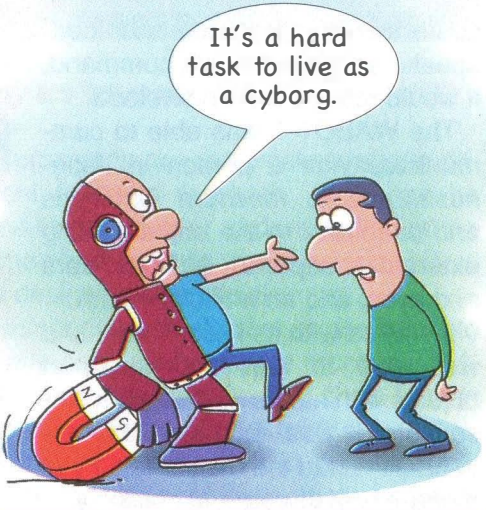
What are cyborgs?

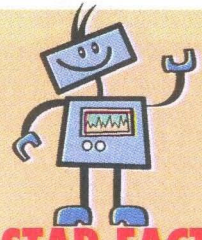
A cyborg is a person whose physical capabilities are enhanced beyond normal human limitations by a machine that modifies the body's functioning.

Originally, a cyborg referred to a human being with bodily functions aided or controlled by technological devices, such as an oxygen tank, artificial heart valve, or insulin pump.

Over the years, the term has acquired a more general meaning, describing the dependence of human beings on technology...or to put it very simply, cyborgs are part human, and part machines.

The term was coined by Austrian scientist Manfred Clynes in 1960 to describe the need for mankind to artificially enhance biological functions in order to survive in the hostile environment of space.

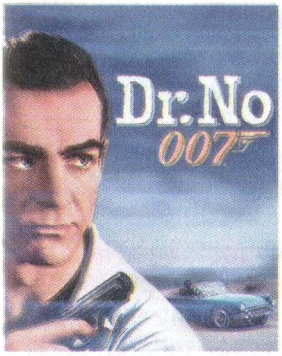


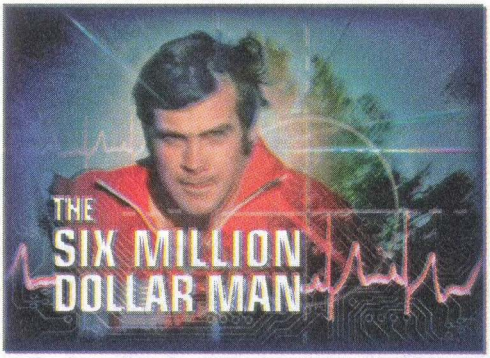


STAR FACT

Nano Robots

Nanorobots are built using the techniques of nanotechnology. These robots are really tiny, and are designed to perform a specific task or tasks repeatedly, and with precision at nanoscale dimensions.





Posters of Dr. No and The Six Million Dollar Man

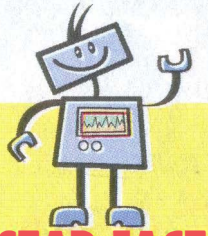
Why have cyborgs become a part of popular culture?

Cyborgs are popular characters in books, television serials, games, and movies. They are portrayed with physical or mental abilities far exceeding a human counterpart.

There is Dr. No from the James Bond films who has metal hands that have terrifying power and Robocop, the central character of a popular movie series.

The television series 'The Six Million Dollar Man,' featured one of the most famous fictional cyborgs, referred to as a bionic man.

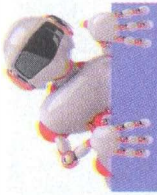
Then there is Darth Vader from the Star Wars films - a tall, dark, scary, disciplined, tragic cyborg who was immensely skilled at piloting!



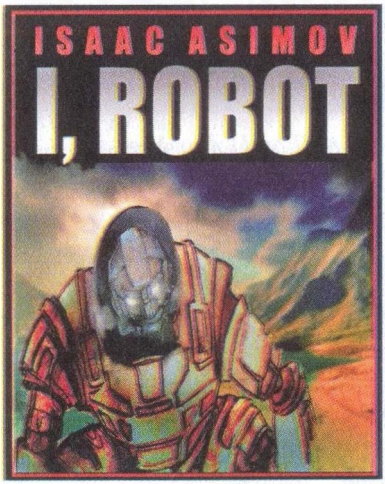
STAR FACT

Swarm Robotics

Swarm Robotics is the study of how to design groups of robots that operate without relying on any external infrastructure, or on any form of centralized control.



ROBOTS IN POPULAR CULTURE



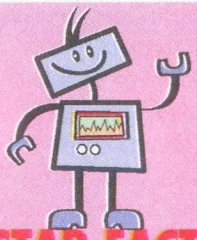
Isaac Asimov's 'I, Robot'

How have robots been inspired by popular culture?

Fiction in books and movies has been an important source of inspiration for the development of robotics.

In ancient civilizations, engineers and inventors tried to build self operating machines resembling animals and humans, inspired by the mechanical servants of the Greek and other gods of mythology.

Though the term robot is comparatively new, the con-



STAR FACT

Androids

Androids are humanoids that look exactly like human beings. So far, they exist only in fiction. Writers describe them as being made up of mechanical parts that are completely covered with realistic looking skin.

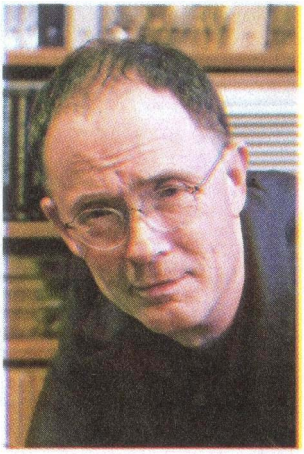
Which are some of the famous robot characters in literature?

Robot narratives are a staple of modern science fiction, but stories about artificial intelligence have been around for centuries.

In recent times, there is the tale of Pygmalion, a sculptor who fell deeply in love with one of his female statues, only to see her come to life.

Amongst science fiction writers, Isaac Asimov is very famous as a large part of his work centres around robots. William Gibson came up with the weirdest robots- Wintermute and Neuromancer who are physically separated twin super-computers.

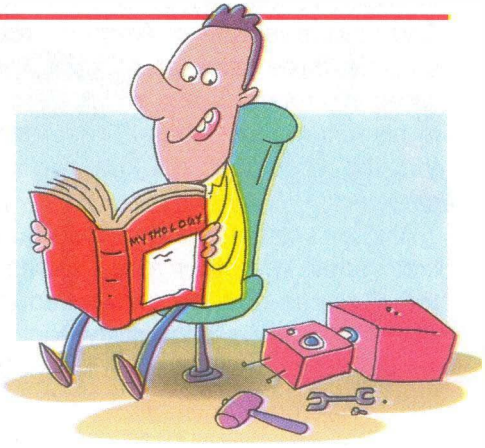
HAL, created by Arthur C. Clarke, is the central operating system of an off-Earth colony—in this case, the spaceship Discovery One. These are just some of the robots found in literature...there are many, many more!

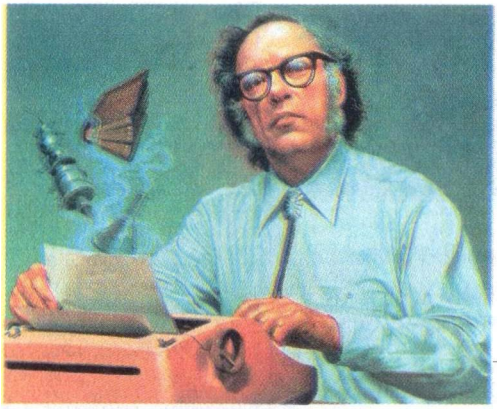


William Gibson

cept of artificial humans and animals has fired the imagination of artists and writers since the earliest times. It is their creations that have inspired the science of robotics and its development.

Today, robots are no longer a figment of the imagination, but a reality.





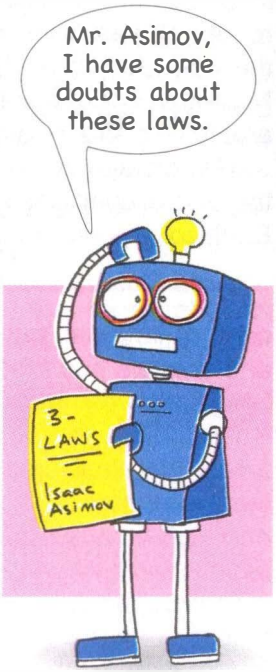
Isaac Asimov

Why is the name Isaac Asimov associated with robots?

Isaac Asimov, a Russian-born, American author, professor of biochemistry, and a highly successful writer, is best known for his works of science fiction.

He is best remembered for his stories in which robots played a crucial role. The unique feature of Asimov's robots are the three laws of robotics, hardwired in a robot's brain, which all robots in his fiction must obey. These ensure that the robot does not turn against its creators.

Asimov's famous work is the Foundation series. His other major series are the Galactic Empire series and the Robot series. His short story 'Nightfall', was voted as the best short science fiction story in 1964.



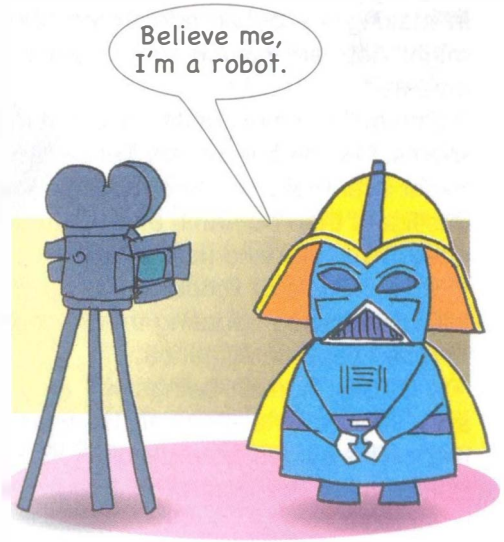
A Poster of 'Star Wars'

Which are some of the famous robots in movies?

Before the 1950s, robots in movies were invariably evil, clanking crates with death rays ...even better if the death ray came out of their eyes. But, Forbidden Planet's Robby, all gleaming metal spheres and politeness, proved that robots could be our friends as well.

C-3PO from 'Star Wars' and the android Data from 'Star Trek' were also immensely popular. Cyborgs were popularised by 'The Terminator' series.

These are just a few of our metal friends which have long been a source of inspiration, wonder, and fear for filmmakers and audiences.



Frankenstein- A Publicity Poster

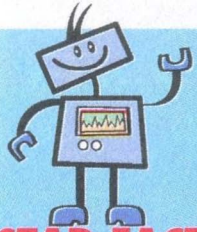
What are the major fears about robots as they are shown in popular culture?

Although movies and books about robots are very popular, they have also played a role in making the public concerned about what might happen if such robots were actually invented.

One of the major concerns is that intelligent robots, like the ones in the Terminator series, might eventually become more powerful and intelligent than humans, and they may either destroy us, or make us their slaves.

Some robots in fiction are programmed to kill, others keep updating their own software to attain super intelligence.

Naturally, human beings will have to fear such robots. The story of the Frankenstein monster is a good example of a robot that has gone out of the control of the person who invented it.



Rubik's Cube

Rubik's Cube is a puzzle in the form of a plastic cube covered with multicoloured squares. The player attempts to twist and turn so that all the squares on each face are of the same colour. It has challenged countless numbers of people. A robot named CUBESTORMER 3 holds the record for solving it in the fastest time so far- 3.253 seconds.

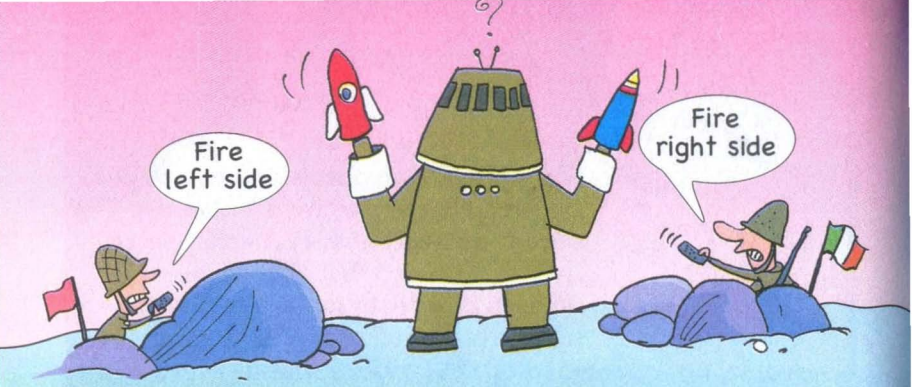
Why are such concerns relevant today?

The widely held concern that robots might eventually become more powerful than humans cannot be laughed off.

As robotic technology becomes more and more sophisticated, robots become more and more advanced technologically.

In fact, some scientists predict that a robot brain will exist by 2019, while others are sure that there will be breakthroughs in robot intelligence by 2050.

When robots are able to think, by upgrading their software, there is the very real danger that they will become more intelligent than humans. This may prove disastrous to mankind.



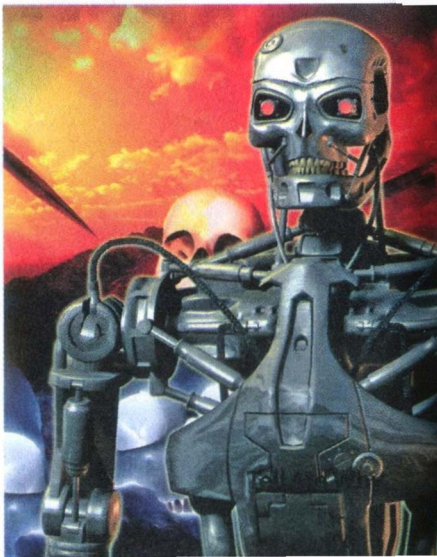
What are the disadvantages of using robots in military operations?

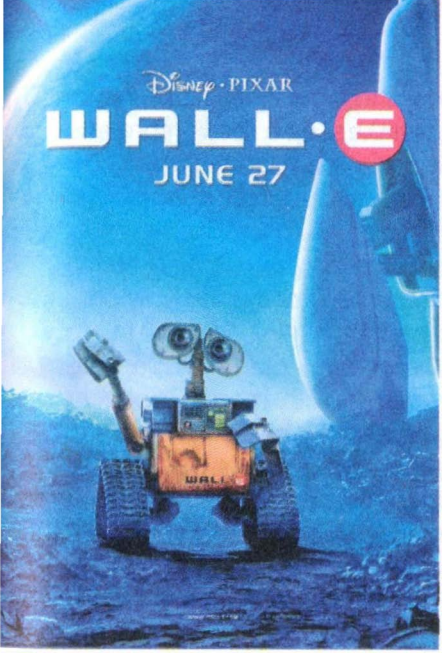
We have spoken about the advantages of using robots in military operations.

However, there are disadvantages too, of which we must be aware. As robots become more complicated, their ability to take decisions on their own increases. These decisions may not always be in tune with the requirements of the military, or the best interests of the country.

There are valid concerns about technology which might allow some armed robots to be controlled mainly by other robots. For example, the military robot EATR can refuel itself from organic substances. This may sound good, but as they forage, these robots may strip an entire area of vegetation, which would be an ecological disaster.

Another major worry is that countries with high-performance military robots may be more inclined to launch attacks.





humans and robots is the Animatrix. The Terminator series brings out vividly the dangers of robots run by an uncontrolled Artificial Intelligence programme.

HAL 9000 in the Space Odyssey series is a computer with advanced AI capabilities which assists humans on a space station. Finally, this computer kills all the humans on board to ensure the success of the mission.

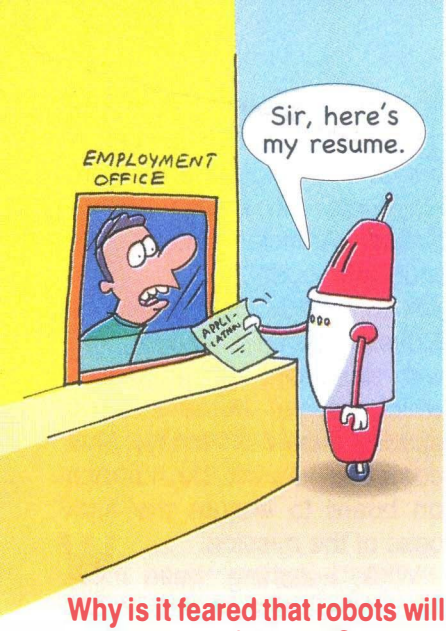
While watching these movies, it is good to remember that what is fiction today can become reality tomorrow.

Which are some famous films that depict the misuse of robots?

There are many films that throw light on how robots can be disastrous to mankind.

One of the most famous is a movie called 'The Matrix. It is about a future in which mankind is destroyed by robots, and by a lack of ethics.

Another film focusing on the ethical issues between



Why is it feared that robots will cause unemployment?

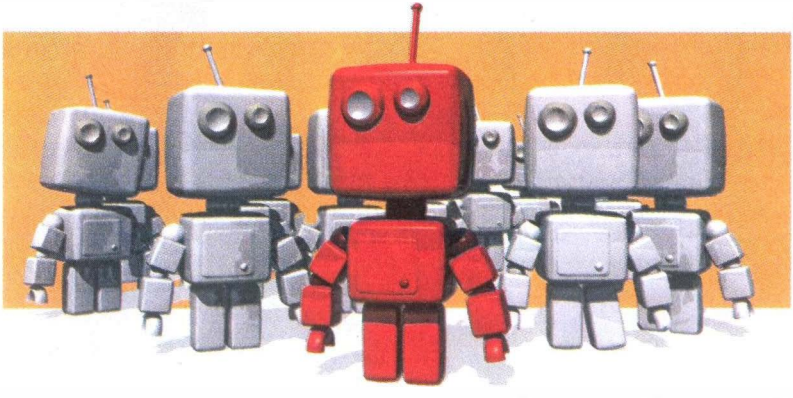
Robots can get a job done faster, cheaper, and more efficiently than humans.

They do not fall ill, go on strike, or make demands. Nor do they get tired and make mistakes. As a result more and more robots, rather than humans, are being employed in factories.

For example, the Taiwanese technology company Foxconn, announced in July 2011, a three-year plan to replace workers with more robots. At present, the company uses ten thousand robots, but will increase them to a million robots over a three-year period.

If this trend continues, in a few years, robots will be the cause of large scale unemployment.

Experts even predict 75 per cent unemployment by the end of the century. That's a very scary prediction indeed!



CURIOUS FACT

Plug & Pray

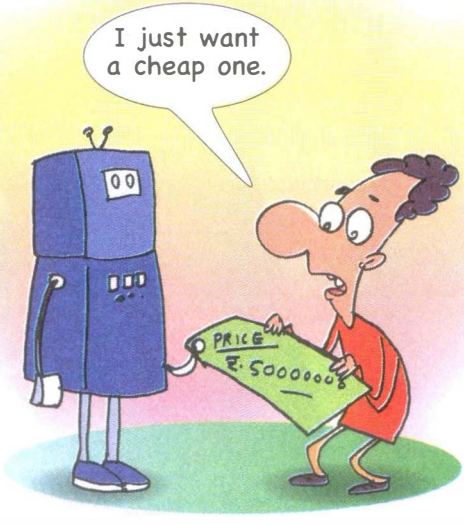
Plug & Pray is a documentary film made in 2010. It deals with the social impact of intelligent robots.

The strategy and planning to achieve a company's goals has to be done by people. Employees also will have to be trained to interact and work alongside robots, and this training is an added expense.

Besides causing unemployment, what are the other disadvantages of industrial robots?

There are some disadvantages too, of using robots in manufacturing and industry.

They are not cheap to produce, and they must be properly maintained, or else they will not work efficiently. Another disadvantage is that robots by themselves cannot guarantee results.



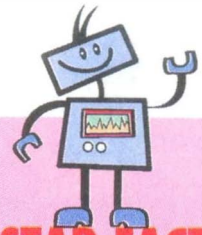
What are the disadvantages of using robots at home?

Robots can be very useful in the home, whether it is helping with household tasks, monitoring children, looking after the elderly, or providing security.

At the same time, they have several disadvantages too. Buying a robot for the home requires an initial expense that is quite heavy. There are maintenance costs for robots too, just as with any other machinery.

Another disadvantage is that robots are programmed only for specific tasks. They are not flexible, or adaptable about the jobs they can do. So, you will need many robots to run a home.

If an emergency arises, a robot cannot take a decision on its own. To put in simply, you cannot trust a robot as you would trust another human being.

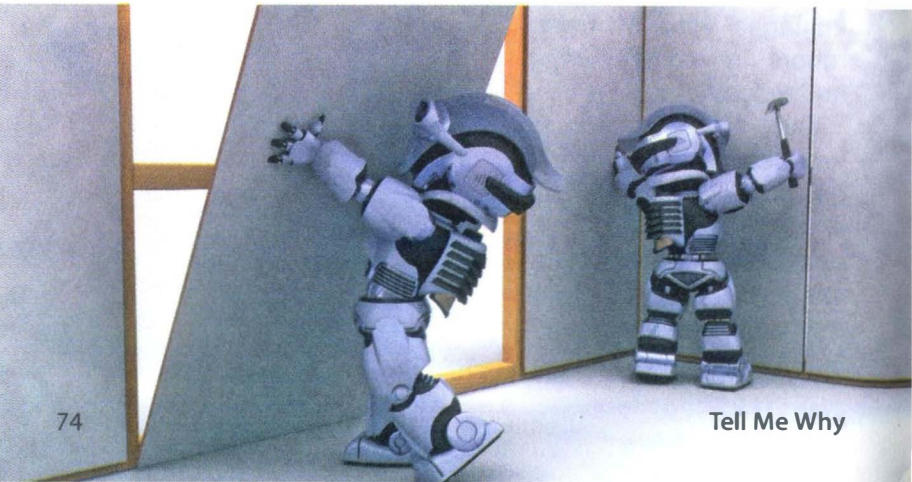


STAR FACT

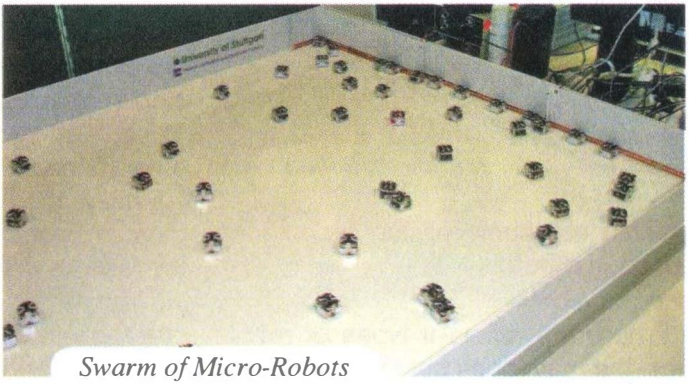
RoboBee

RoboBee is a tiny robot modelled after an insect. It can fly, and has a wingspan of just 3 cm. RoboBee was developed at Harvard University.

● *Radha Nair*



A LOOK INTO THE FUTURE



Swarm of Micro-Robots

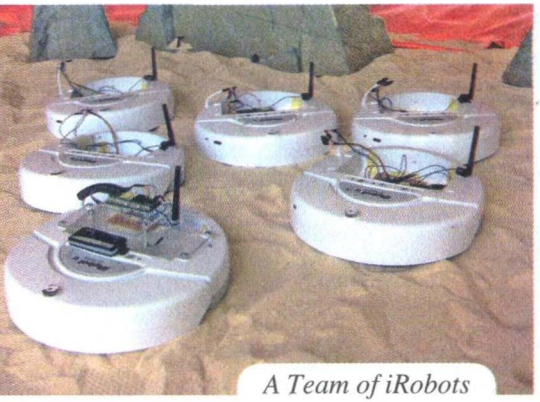
What is the importance of swarm robotics?

When thousands of tiny robots are used together to perform specific tasks, they are known as a swarm of robots.

A single robot of the swarm is a simple machine which cannot do very much. But working with 1,000 or more like-minded fellow robots, it becomes part of a swarm that can perform complex, highly sophisticated tasks like spying, or searching for missing objects.

The great advantage of a swarm is that while one large robot may fail and ruin a mission, a swarm can continue, even if several robots fail.

So, swarm robotics has a bright future, especially in fields like space exploration.



A Team of iRobots

Which are some of the techniques used in robotics?

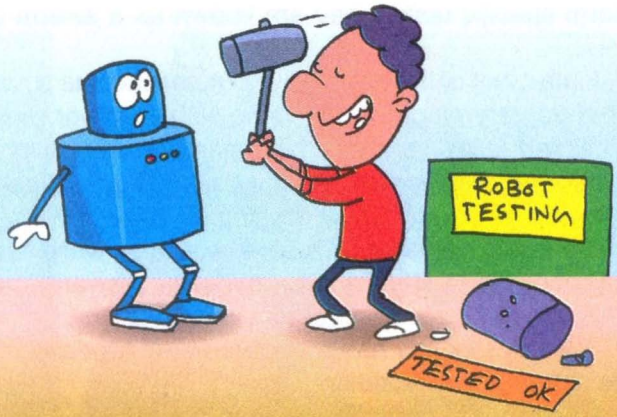
There are different types of robotics, the main ones being evolutionary and developmental robotics.

In evolutionary robotics, a number of differing robots are submitted to tests. Those which perform best are used as a model to create a subsequent 'generation' of robots.

Developmental robotics, on the other hand, tracks changes and development within a single robot in the areas of problem-solving and other functions.

Finally, there is commercial robotics. Here the focus is on developing robots for commercial applications.

Japan, for example, hopes to have full-scale commercialization of service robots by 2025.



Why is it important to develop a computer operating system exclusively for robots?

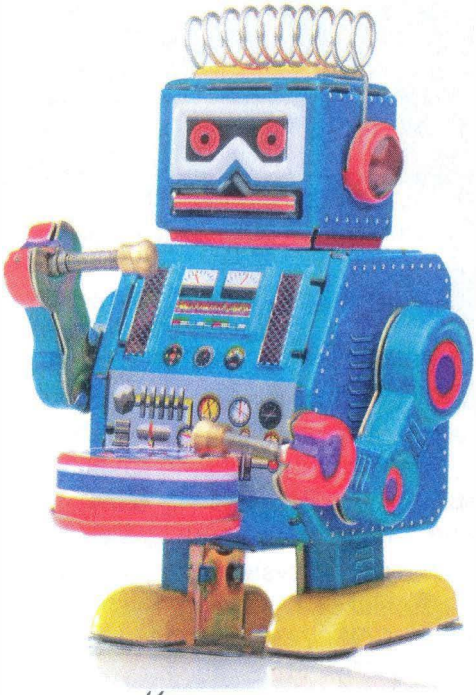
We know that all robots have to be controlled by computers.

As more and more robots are being used, it has become important to develop a computer operating system exclusively for robots.

Microsoft, Stanford University, the Massachusetts Institute of Technology, and the Technical University of Munich are some of the institutions that have focused on developing such a system. Known as the Robot Operating System or ROS.

The ROS development is an ongoing joint effort within the robotics community.

ROS is based on a programme called Switchyard, written by Morgan Quigley at Stanford, and has seen numerous contributions since then, from institutions around the world.



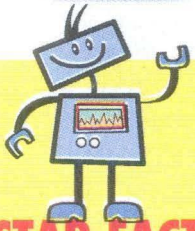
Why is the future of robotics a bright one?

The robotic industry is looking ahead to a bright future, without doubt.

Many governments, along with private organisations, are spending huge amounts of money in this field. In universities around the world, robotics is the subject for study for the brilliant students.

Research in Artificial Intelligence is gathering steam, and industry is depending more and more on robots to increase productivity, and cut down on recurring costs.

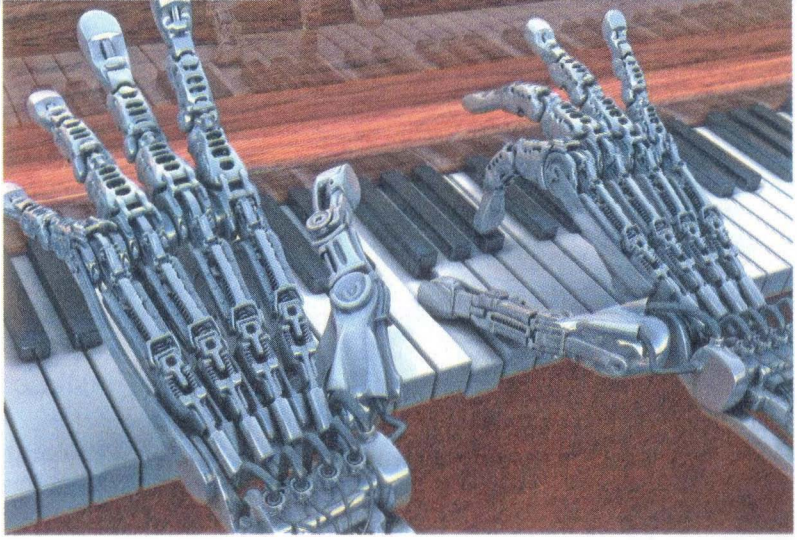
New technologies are opening doors to completely new applications for robots.



STAR FACT

Animatronics

The term animatronics refers to robot actors in films and television. It is a field of robotics that uses very advanced technology to achieve realistic effects.



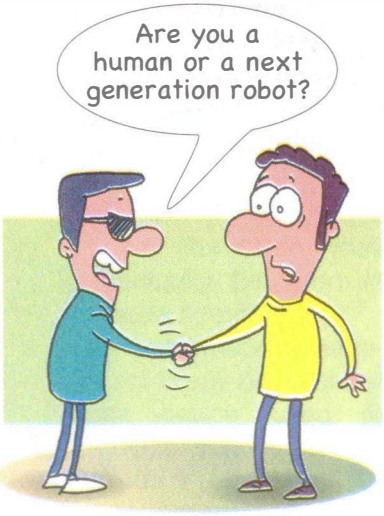
How will the next generation robots look like?

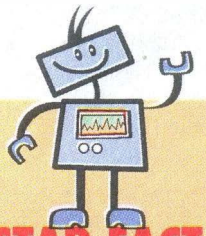
The next generation of robots will look much more like humans than the present one.

They will have realistic looking skin and hair, while embedded sensors will enable them to react most naturally to their surroundings. These robots will have artificial eyes that both blink and move.

They will have artificial facial muscles that allow them to change their expressions, and artificial intelligence that makes it possible for them to interact in very human ways.

In fact, it will be a rather difficult task to distinguish them from humans... except for the fact that they won't bleed when cut, cry when sad, and laugh when they're happy.





STAR FACT

Genghis

Genghis is an insect robot- one of the first to be built. It has six legs, and can move over uneven ground. If it encounters an obstacle, it just backs off, and takes another route.

● *Dev Nath*

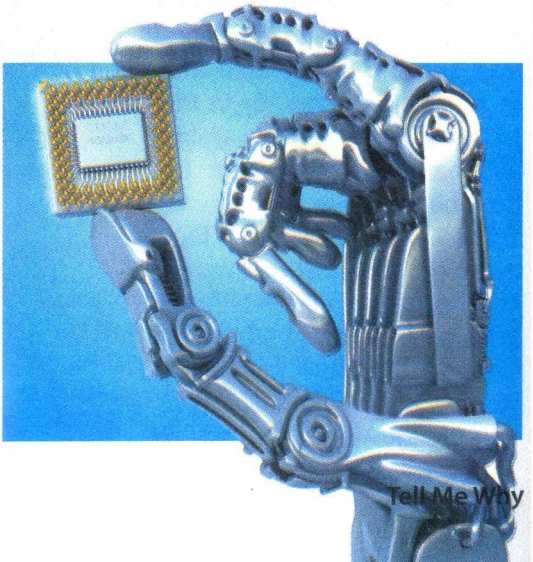
What is the importance of All Terrain Robots or ATRs?

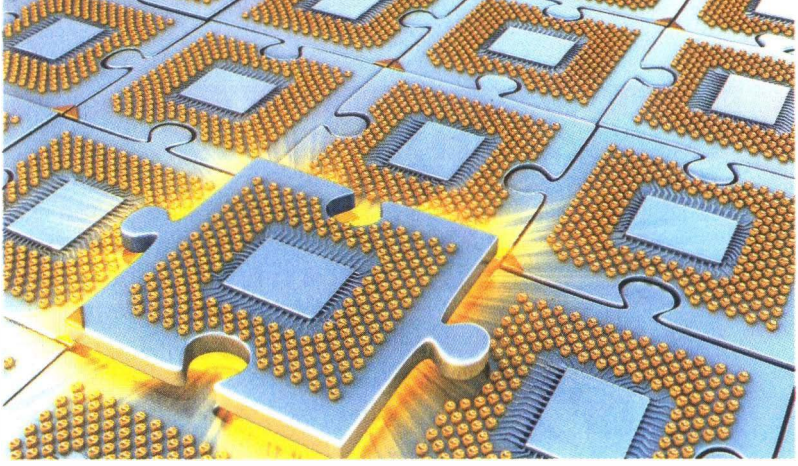
All Terrain Robots are those that can move not just on smooth surfaces, but on any kind of surface- rocky or rough, uphill or downhill, slippery or steep.

All Terrain Robots can have wheels or legs to move around, and are equipped with camera, sonar, and heat sensors.

Smaller ATRs can be fitted inside a larger one, and sent out in different directions for search and rescue missions. They then function as a team by sharing their locations, discoveries, search patterns, and more.

ATRs are extremely important in such operations because they can reach places where humans can't, and can work in a hostile environment.





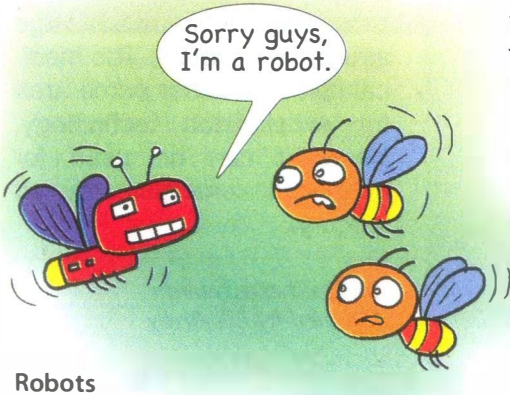
How can robotic insects and cybernetic hands change the future?

We know that insects have survived for millions of years, because of their ability to adapt to changing situations.

Robotic insects will also be able to function like them in many ways, including cooperation, specialized movement, and adapting to changing environment.

Scientists in the US have created a robot the size of a fly that is able to perform the agile movements of this insect. This 'robo-fly', built from carbon fibre, weighs a fraction of a gram, and has superfast electronic 'muscles' to power its wings. These tiny robots may eventually be used in rescue operations.

A cybernetic replacement is any biomechanical device used to replace body parts like hands.



What are robotic exoskeletons?

A robotic exoskeleton is a metal skeleton with a motor that is strapped to the arms or legs of the person wearing it.

The main function of a powered exoskeleton is to assist the wearer by boosting his strength and endurance.

Robotic exoskeletons are a great boon to those who have difficulty in moving without assistance. They are commonly designed for military use, and are also useful in industry and construction sites. Robotic exoskeletons can help workers carry heavier loads, and help rescue workers shift heavy objects.

In the future, robotic exoskeletons may be useful for astronauts who build large structures in space. The medical field is another prime area for exoskeleton technology, where it can be used for enhanced precision during surgery.

Powered exoskeleton designed by US Army

ROBOTICS IN INDIA

Daksh - Robotic Vehicle developed by DRDO

What do we know about robotics in India?

There is a great deal of interest in India about the science of robotics.

Since 1980, there have been many institutions that are engaged in research in this field. In addition, more and more industries are using robots across a range of sectors such as automotive, atomic energy, defence, space, metals, textiles and manufacturing, in addition to research.

In fact, robots are required everywhere to improve productivity. They are also being used in operation theatres and rehabilitation centres to augment the quality of life.

As a result, the production of robots is increasing.

CURIOUS FACT

Tiger's Tiger

Tippu Sultan, the 18th century ruler of Mysore was also known as 'The Tiger of Mysore'. He had a mechanical wooden tiger which was built in about 1795. When the handle on the tiger's shoulder is turned, it growls and attacks the model of a British soldier.

What is the future of domestic robots in India?

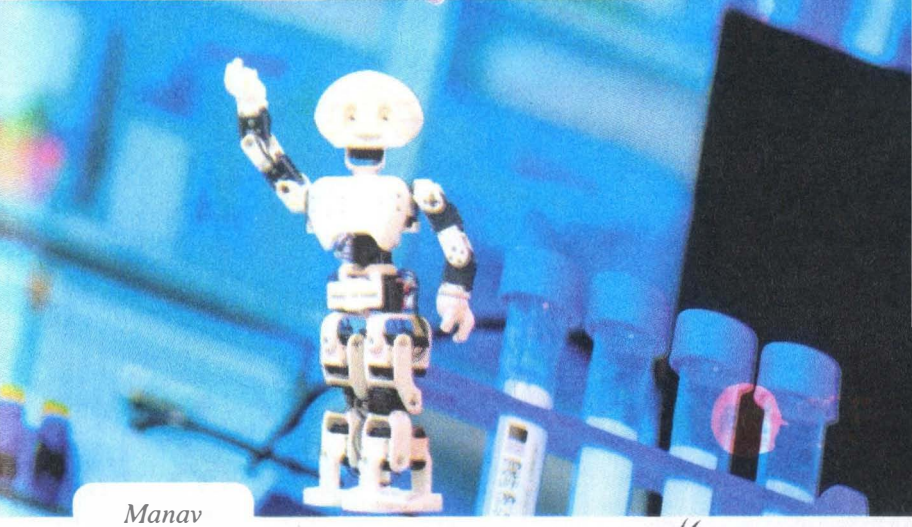
In a country like India, where labour is still plentiful, one would think that there would not be much scope for selling domestic robots.

However, as domestic help becomes more expensive, harder to find, and more demanding, people slowly understand the advantage of using robots for cleaning the house.

Today, robots can do jobs like mopping floors, dusting carpets, and scrubbing the marble top kitchen counter.

There are also robots for cleaning the lawn, the swimming pool, and large glass windows.

The robotic cleaner market in India is still in its infancy. Milagrow Human Tech, a Gurgaon-based firm that manufactures domestic robots like RoboCop, claim they have sold 2,500 units since their launch.



Manav

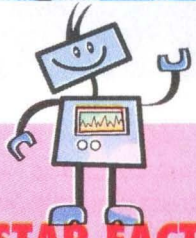
What is Manav?

Manav has the distinction of being India's first 3 D printed humanoid robot.

Built with 21 sensors, two cameras in its eye sockets, and two mikes on either side of its head, Manav is 60 cm tall, weighs 2 kg, and can walk, talk, and dance on command. It can be programmed to do different jobs as required.

Manav- which means 'man' in Sanskrit, is the creation of a team of students from the A-SET Training and Research Institute, New Delhi.

This humanoid is being sold for a price of Rs 1.5 to Rs 2 lakh, which is much lower than that of other robots in the market.



STAR FACT

Botlr

Butlers are becoming extremely hard to find nowadays, so a California company, Savioke has developed a robot butler. It is called Botlr, is a metre tall, and can carry up to 50 kg.

● *Sneha Rao*

Head Office of DRDO, New Delhi

Does India have robotic soldiers?

India is working on developing robotic soldiers, and with futuristic warfare in mind, DRDO labs are working hard at boosting the nation's unmanned fighting capabilities.

The idea is to develop robots with a very high level of intelligence that would enable them to differentiate between an enemy or threat, and a friend. These robots can be sent to difficult warfare zones like the Line of Control, so as to minimize loss of human lives.

The ultimate goal of the DRDO is to develop autonomous robots which can operate in the front line of battle, and can recognize enemy weapons.

MOM

MOM stands for India's Mars Orbiter Mission. It was a totally indigenously made unmanned robotic mission, and as Indians, we all take pride in its success.

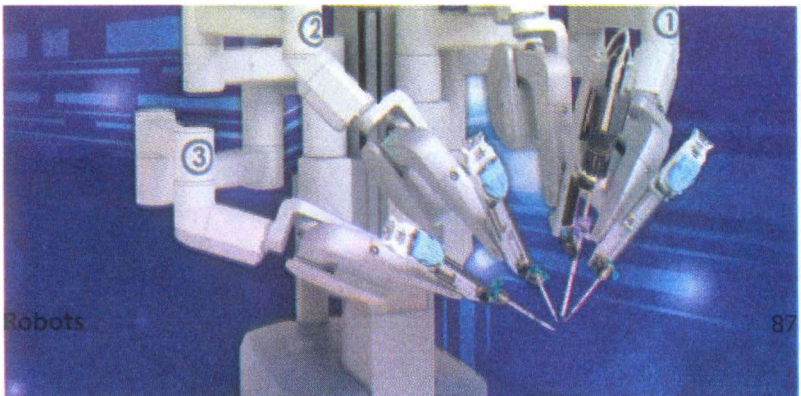
What is the future of robotic surgery in India?

Robotic surgery in India is still in its infancy, but India is one of the few countries in the world where it has happened.

India has excellent surgeons, but the patient volume is very high. As a result, there is a shortage of skilled surgeons and opportunities abound for the growth of robotic surgery.

In 2010, India's first robot–assisted surgery was conducted by Dr. Dogra, at the All India Institute of Medical Sciences. The robotic system that made it all possible is the da Vinci Surgical System.

Robotic Surgical System



ROBOTS IN THE NEWS

Modern Banker

NAO is a 58 cm tall humanoid robot. He is small, cute and round, moves, recognises you, hears you, and even talks to you!

The Mitsubishi UFJ Financial Group Inc., a famous bank in Japan, has introduced a NAO robot to improve its banking services, and by doing so, has become the first bank in the world to use robots at branches.

This robot, which speaks 19 languages, greets customers when they enter the bank, and asks them how it can help them.

Developed by Paris-based Aldebaran Robotics, this NAO robot will herald an era of futuristic banking, not only in Japan, but hopefully, all over the world.

Robo War!

Robotic Tanks designed by the US Army.

Music Robot

The robot flautist WF3-RIX, which can play a real flute.

Robear

Robear is a robot that can look after you when you grow old. Developed by Japan's famous robotic research centre Riken, Robear can help to move elderly and disabled persons to wheel-chairs and beds.

It has special sensors that make its movements very gentle, and has mechanical arms that are able to carry up to 80 kg of weight.

Robear also has roller legs that can extend and retract from a base, when bending to lift a patient. Robear weighs 140 kg, and its movements are slow and smooth, so as not to hurt the person it is carrying in any way.

Firefighter Robot

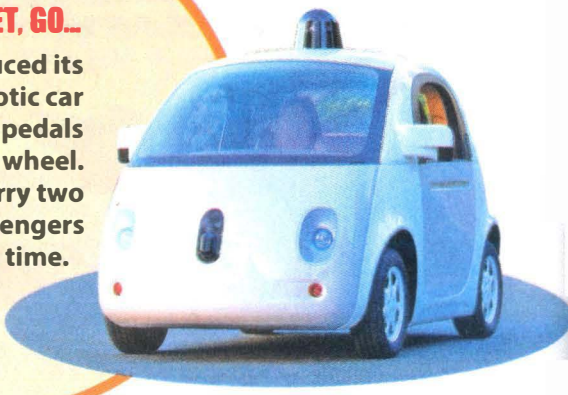
SAFFiR is a firefighting robot developed by the US Navy. SAFFiR stands 1.77 metres high, and weighs 70 kg. The unique design of the robot equips it with super-human range of motion to manoeuvre in complex spaces including narrow passageways, ladders, and hatches on board a ship.

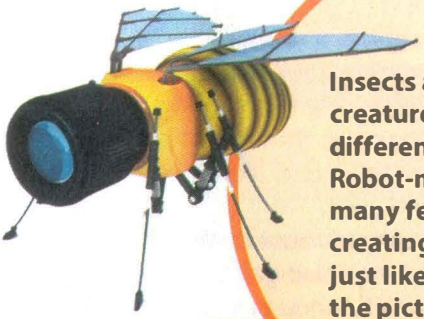
It is equipped with a suite of sensors that include a camera, a gas sensor, and an infra-red camera that will allow it to find its way through the smoke.

It can throw fire-retarding grenades, as well as handle a fire hose on its own.

GET, SET, GO...

Google introduced its first driverless robotic car in 2014. It has no pedals and no steering wheel. This car can carry two passengers at a time.





Fly like a Bee..

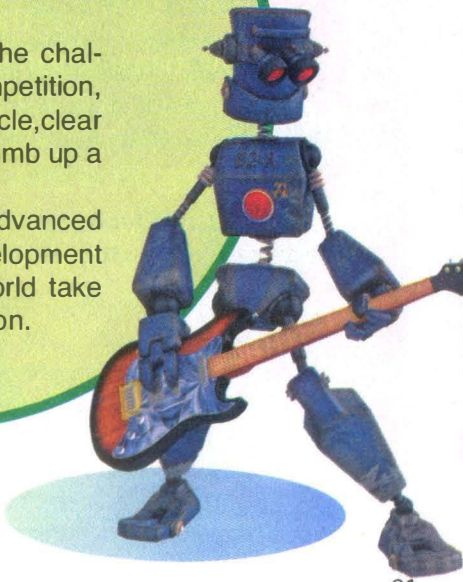
Insects are very successful creatures that can live in different conditions. Robot-makers have copied many features of insects in creating robotic insects, just like this robotic fly in the picture.

Robotic Challenge

DARPA Robotic Challenge is a competition between robot systems and software teams to develop robots that are capable of assisting humans in responding to natural and man-made disasters.

Many teams participate in the challenge, and during the competition, robots have to drive a vehicle,clear debris from a doorway, and climb up a ladder.

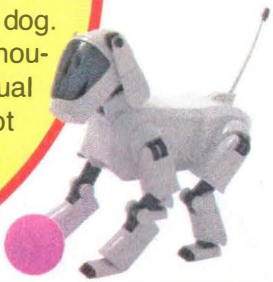
Some of the most advanced robotic research and development organizations in the world take part in this competition.



Meet Spot

Boston Dynamics, a robotic company, has a new four-legged addition to its family. It is a robotic dog named Spot, and it can run through office corridors, up concrete stairs, and along rocky hills with little trouble.

The electronically-powered robot is meant to have the rough appearance and gait of a dog. However, one striking difference in its silhouette is the head. Rather than having visual sensors on a head-like structure, Spot is able to see the environment with a rotating sensor on its back.



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ROBOT DICTIONARY

AI: Artificial Intelligence, the science that helps to make machines with intelligence.

Automation: The use of machinery that can move by its own power.

Automaton: A machine with a hidden mechanism, that imitates the movements of human beings or animals.

Controller: The part of the robot that co-ordinates all the movements.

Degree of freedom: The term used to describe the directions in which a robot can move.

Feedback: Information about the robot's surroundings, usually obtained by sensors and transferred to controller.

Nanotechnology: The science of building machines and robots of the size measured in nanometre.

Service robots: A term used to mention all the working robots outside the factories.

Telerobot: A robot that is partially or completely controlled by a human operator via a remote control system.

Yaw: Side-to-side movement of the robot's wrist joint.

Great news for little ones! From the magic-land of Disney.

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I Wonder Why?

Question of the Month

Why is it easier for us to remember the lyrics of a song than the notes we take in class?

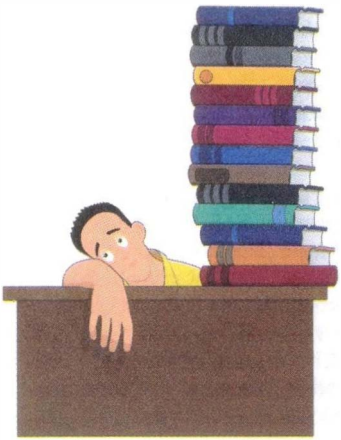
There are many reasons why we remember the lyrics of a song easily. The brain retains rhyming patterns, rhythm and melody with ease.

On the other hand, prose and dry facts do not capture our interest nor remain in our memory unless we put in a lot of effort.

Moreover, we all enjoy learning the lyrics of a song because as we are doing so, we at once connect it to the voice of the singer crooning it, the magic of the background music and the sound of the instruments that are used.

Unfortunately, our academic lessons do not have such delightful connections to make them easy to learn and remember!

● *Indhu Thomas*



Question sent by:
Vishal Singh, Lucknow

Send us your questions
E mail: **tellmewhy@mmp.in**

SPECIAL CONTEST WINNERS

Winners of the **Special Contest** held in the JANUARY issue **BEST OF TELL ME WHY**

1. **Saeesh M.S.,** Bengaluru.
2. **Namita Tonse,** Mumbai.
3. **Tulasi,** Chennai.
4. **Parinith Ramakrishna.** Bengaluru.
5. **Sarbajit Chandra,** Kolkata.
6. **Shreyas S.,** Bengaluru.
7. **Rwitik Mukherjee,** Thane
8. **S. Padmesh,** Coimbatore.
9. **Debarka Chakrabarti,** Bengaluru.
10. **K. Maureta Sruti**, Tiruppur.
11. **Mamta Ghosh,** Gurgaon.
12. **Asmita Dutta,** Kolkata.
13. **Rishita Sinha,** Mumbai,
14. **Swapneel Mishra,** Coimbatore.
15. **Amogh Saraf,** Bengaluru.
16. **Archan Ganguly,** Kolkata.
17. **Lalitha Ramaswamy,** Thane.
18. **Sovit Atri,** New Delhi.
19. **Navya Elizabeth John,** Mumbai.
20. **Abhishek V. Bannurkar,** Bengaluru.
21. **Swapnil Sengupta,** Kharagpur.
22. **Arifa Nasees,** Etah.
23. **Aditi Kapoor,** New Delhi.
24. **Bhagyashree L. Narayanan,** Mumbai.
25. **Aishwarya C.,** Bengaluru.
26. **Aditya Agrawal,** Kolkata.
27. **Vikash Anand,** Purnea.
28. **Simran Meher,** Bengaluru.
29. **Pravinkumar Dnyaneshwar Hatagale.** Mumbai.
30. **Tanmay Chachan,** Muzaffarpur.
31. **Samyajyoti Biswas,** West Midnapur.
32. **Sarmistha Ghosh,** North 24 Parganas.
33. **Shakthi Nagaraj,** Coimbatore.
34. **Ishaa Ajay,** Kottayam.
35. **Ketaki Patil,** Mumbai.
36. **M.N. Ananthakrishnan,** Coimbatore.
37. **Vibhansh Gupta,** Jammu.
38. **Parul D'souza,** Mumbai.

39. **Soumyadeep Das,** North 24 Parganas.
40. **Aishwarya Dinesh Kumar,** Kannur.
41. **Praisee Eldo,** Tamil Nadu.
42. **Hriju Datta,** Nadia.
43. **Satish S. Acharya,** Coimbatore.
44. **Parshav Jain**, Mumbai.
45. **Arka Mandal,** Medinipur.
46. **Nandhana Raj,** Kollam.
47. **Agniv Chatterjee,** Howrah.
48. **Utkarsh Panda,** Bhubaneswar.
49. **Sankalp Mishra,** Nasik.
50. **Haritha Sajikumar,** Alappuzha.
51. **Shilpa Sajeev,** Mumbai.
52. **S. Gowtham Krishna**, Tirupur.
53. **Krupali Jaynar,** New Delhi.
54. **Vighnesh V.,** Alwaye.
55. **B. Manmadha Rao,** Mumbai.
56. **Rimilmandrita Ghosh,** Nadia.
57. **M. Nithish,** Coimbatore.
58. **Poornima Mohan Acharya,** Mumbai.
59. **Shrikant Shinde,** Pune.
60. **S. Jayalakshmi,** New Delhi.
61. **M.D. Farhaan Ahmed,** Kolkata.
62. **Rohan Aggarwal,** Haryana.
63. **Tom Thomas,** Wayanad.
64. **Parth Pravin,** Mumbai.
65. **Indranil Banerjee,** Kolkata.
66. **Shubham Uday Vidya Tanpathak,** Mumbai.
67. **Anila C.B.**, Alappuzha,
68. **Jishnutosh Majumdar,** Kolkata.
69. **Lakshmi Kanta Chowdhury,** New Delhi.
70. **S. Purkayastha,** Shillong.
71. **Viraaj Kulshreshtha,** Mumbai.
72. **Ajay Kumar Singh,** Muzaffarpur.
73. **Agnel Maria Reji,** Idukki.
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